UTILISATION OF SOLAR ENERGY

AT the present rate of fuel consumption it has been estimated that the world's supply of readily available fuels such as coal, oil and gas will be exhausted in less than 100 years. Nuclear fuels too, are likely to last only for about another two centuries. As a long-range problem, therefore, researches on methods of utilizing solar energy are of vital importance, particularly in countries like India, which are fortunately situated in regard to the supply of solar radiation. In this connection, the deliberations of a recent symposium* on the utilization of solar energy, sponsored by the National Science Foundation and the University of Wisconsin, U.S.A., will be read with much interest.

The first general discussion at the symposium

* Held at the University of Wisconsin in September 1953, reported in *Science*, 1954, **119**, 82.

centered round the storage and utilisation of solar energy for house heating, water heating and cooking. The discussion indicated that knowledge of absorbents of solar energy was well advanced, but that considerable improvement was still necessary before solar house heating could be achieved without the use of auxiliary fossil fuels. One of the major problems in this connection is the storage of energy through the night, and during long periods of overcast or stormy weather. Probably, improvements in house design would make possible better use of the sun's heat in both summer and winter.

Regarding the generation of solar power, it was felt that small power units could be got up in certain parts of the world, though at from 2-3 times the current cost of power production

from coal and oil. The chief disadvantage here is that the power would be intermittent because it can be produced only during the hours of sunlight.

Closely allied to the power problem is the solar evaporation of sea-water. Some progress in this regard has been made by dissolving dyes in salt water in order to improve the absorption of energy. One part per million of dye may increase absorption by as much as 30 per cent. in the evaporation of water to yield salt.

But it is obvious that for any widespread use of solar energy, there must be a better understanding of the meteorological implications. If improved methods for protecting crops against frost could be devised, and the growing season thus lengthened, the food supply in certain areas of the world could be increased appreciably. Conversely, if absorption could be induced on snow surfaces so that melting would be speeded up the ground would be made available for planting sooner in the spring. Meteorology could thus make an important contribution to the advancement of solar energy by developing an improved method for specifying the amount of solar radiation at any given point on the globe.

The Conference gave special attention to those areas that show the greatest promise of making major contributions to the utilization of solar energy as a source of power and felt that chemists should be urged to search for a suitable solar compound which will absorb sunlight through photochemical reactions, store up the energy and then release it in a way suitable for practical use. To discover such a compound presents a real challenge, but basic research on the question should be encouraged; for the use of sunlight in photochemical reactions offers many theoretical advantages over its use as heat in engines. However, one of the difficulties likely to be met with is that the products of such photochemical reactions may immediately react, and reverse the reaction.

An example of a possibly useful photochemical reaction is the production of hydrogen and oxygen from water, using cerium salts as the absorbent to transfer the energy needed to make the water dissociate. The hydrogen and oxygen could be stored and later recombined to give back the stored energy. Another possibility is the absorption of energy by one side of a photovoltaic cell or an electrical battery, while the second side of the cell is kept in darkness. The side absorbing the energy from the sun would transmit the energy through an electric circuit to the side which is kept in darkness.

In addition to studies of the kind mentioned above, considerably more work should be done on the thermo-element method, in which two different electric conductors are connected, with one junction heated by the sun and the other junction kept cold. The resulting current could be made to do work; however, it will be necessary to find metals or alloys which, when connected together in this way, will produce substantially higher voltages than any produced so far.

Nature's own method of utilizing solar energy in growing plants through photosynthesis is a remarkable phenomenon which can also guide us in our approach to the collection of solar energy. We are just beginning to understand photosynthesis, but perhaps eventually the same series of reactions may be produced artificially without any requirement of the growing plant or good soil conditions.

Considerable attention was devoted at the symposium to the possibilities of a 'poor man's solar engine'. Although such engines would be inefficient thermodynamically and economically in comparison with modern engines, it was felt that they might find extensive use, particularly in countries which are not industrialised. The night interruption of power would not be a disadvantage in operations such as the pumping of water for irrigation.

No great achievements of practical value were reported in this attack on the problem of utilizing solar energy, and it was generally agreed that no new era of direct utilisation of solar energy is yet in sight. However, many of the participants of the Conference, including architects, engineers, chemists and meteorologists, were pleased to find that substantial progress is being made in the preliminary development of solar house heating, solar power production, evaporation of sea-water, and in the application of meteorology. They were also interested to discover that there are many areas of physical chemistry, physics and engineering where fundamental research may well lead to significant advances in this direction.

SPECTROSCOPIC MEASUREMENT OF THE DIURNAL VARIATION
OF THE EFFECTIVE OZONOSPHERE TEMPERATURE

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THERE appears to be so far no experimental determination of the diurnal variation of the temperature of the ozonosphere. As a considerable amount of solar energy is absorbed by this layer in the ultra-violet region of the spectrum it should be expected to undergo a diurnal variation in temperature.

This problem has been theoretically examined by a few workers, but their results vary considerably, as accurate data on the vertical distribution of ozone and the spectral energy distribution of the sun in the ultra-violet region were not available to them. For example, Penndorf[1] has calculated the diurnal range of ozonosphere temperature as $0 \cdot 3°$ C., while Gowan[2] gives a value of $30°$ C., and London[3] $4 \cdot 5°$ C. for the 45-50 km. region. Recently, however, Johnson[4] utilising the direct measurements of the above quantities made with V-2 and Aerobee rockets at White Sands Proving Grounds, New Mexico, has calculated the range to be of the order of 5-6° C. for a height of 48 km.

The experimental determination of ozonosphere temperatures made with rockets are yet too few to enable one to estimate the diurnal variation of the temperature of the ozonosphere. A. Adel[5] has made spectroscopic measurements of ozonosphere temperatures using the $9 \cdot 6 \mu$ ozone band, but as his measurements require the presence of either the sun or the moon, it is not always possible to make a complete series of readings to get an idea of the diurnal variation. The present writer has developed a method similar to Adel's, by which measurements can be made both day and night so long as a clear patch of sky near the horizon is available.

The method essentially consists in comparing the emission of the thermocouple detector in an infra-red spectroscope at $9 \cdot 6 \mu$, with the emission of the atmospheric ozone layer at the same wavelength, which is the centre of the strong rotation-vibration band ν_2 of ozone. Since the temperature of the detector in the spectroscope is kept constant and is known, the temperature of the ozone layer can be obtained from a simple graphical solution using a series of Planck's curves.

The spectroscope, which is a Beckman model IR-2 with KBr-prism, modified for use with external radiation sources (Momin[6]) is directed through front-aluminised reflectors to the clear sky as close to the horizon as possible, and the wavelength is set in the 9μ region in which the atmosphere is almost completely transparent. On account of this transparency of the atmosphere the thermocouple is radiating out to space, which may be taken to be at the absolute zero, and thus undergoing cooling at a rate determined by its temperature according to Planck's Law. This cooling appears as a negative e.m.f. in the thermocouple circuit which can be measured by reversing the phase of the mechanical synchronous rectifier of the IR-2 Spectroscope, in relation to its beam modulation. Now the wavelength range between 9μ and $10 \cdot 5 \mu$ is scanned with readings being taken at intervals of $0 \cdot 1 \mu$. A plot of these deflections against wavelength gives a curve which is the envelope of the Planck curve for the radiating thermocouple, superimposed on which is the emission band of the atmospheric ozone with its centre at $9 \cdot 6 \mu$. Since the emission of ozone is in the opposite direction, it appears as a decrease in the emission of the thermocouple as shown in Fig. 1. The relative value of
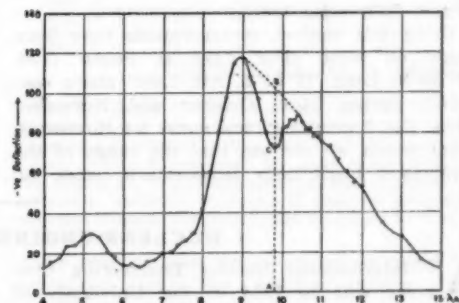

FIG. 1.

$J\lambda - 9 \cdot 6 \mu$ for the thermocouple is given by AB and the $J\lambda - 9 \cdot 6 \mu$ for ozone layer by BC. Since we know the temperature of the thermocouple, which is kept constant by means of a thermostat, the corresponding equivalent black body temperature of the ozone layer for giving emission equal to BC can be obtained from black body emission curves based on Planck's Law. One measurement of the ozone temperature takes only a few minutes.

3

The thermocouple being at constant temperature, a fixed value for AB is assumed and thus the effect of any background radiation due to water vapour or dust is eliminated in the estimation of the diurnal variation of ozonosphere temperature.

The two main assumptions in this method are :

> (i) that the ozone layer is emitting like a black body ;
>
> (ii) that any diurnal variation in the quantity of ozone does not affect the readings.

Since we are using a portion of the sky about 10° above the horizon, the ozone mass involved is approximately 5 times that in a vertical direction and with the normal amount of ozone at Poona which is about 0·16 to 0·18 cm. (at N.T.P.), we should obtain absorption almost approaching saturation at the centre of the band. This is verified experimentally by the fact that very close to the horizon our records show absorptions of the order of 92 to 95 per cent. This means that in assuming the ozone layer as a complete absorber at the centre of the band, we are underestimating its emission by only a small percentage ; but, for determining the diurnal range of temperature, which is our main purpose, the error involved is negligible. The fluctuations in the amount of ozone also have very little effect on the ozone emission as the absorption at the centre of the band is almost fully saturated.

Using this method, measurements have been made on some clear days at Poona (Lat. 18° 30′ N, Long. 73° 51′ E, Alt. 1,800′ above sea-level) during May, October and November 1953. Fig. 2 gives a typical curve for November, from which we can see that the range of the equivalent black body temperature comes out

as about 15° C. The readings for May and October also give a range of the same order although in May the ozonosphere temperature appears to be slightly higher, thus indicating the possibility of a seasonal variation. It must

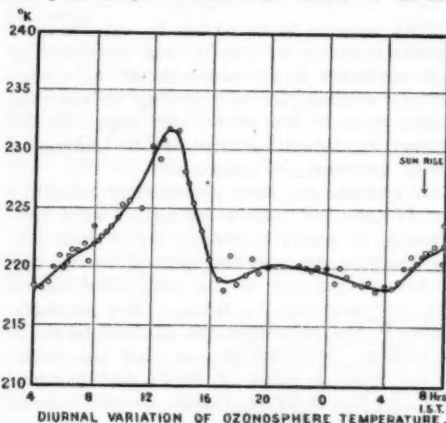DIURNAL VARIATION OF OZONOSPHERE TEMPERATURE.

FIG. 2.

be pointed out, however, that the above results are preliminary and we need a much longer series of data for more definite conclusions.

The writer wishes to express his best thanks to Dr. L. A. Ramdas, for his kind interest and encouragement and valuable discussions, and to the C.S.I.R. for financing the research scheme.

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NUCLEAR ENGINEERING CONGRESS

AN International Nuclear Engineering Congress will be held at the University of Michigan in Ann Arbor, June 20-25, 1954. This is the first public meeting of its size devoted entirely to the peacetime uses of the atom. Over a hundred papers and addresses have been scheduled to be presented during the six-day meeting, twelve of which are from authors in Canada, England, Belgium, France, Norway, Italy, Spain and India. The technical programme consists of some ninety papers on the following subjects : materials of construction for reactors, reactor technology, research and educational reactors, reactor fuel refining and preparation, nuclear power reactors, processing of irradiated materials and applications and uses of radioactive products. In addition to the above there will also be a symposium on 'Education in the Nuclear Field' and an 'Atoms for Peace' exposition featuring radiation, reactor models and instruments. Educational displays will also be held in the galleries of the Rackham Building at the University concurrent with the Congress. Further particulars can be had from Prof. Robert R. White, University of Michigan, Ann Arbor, Michigan (U.S.A.).

IMPURITIES IN CERTAIN PHOTO-CHEMICAL SYSTEMS INVOLVING RADICALS IN AQUEOUS SOLUTION

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HABER AND WEISS[1,2] explained that the Fenton's reaction of hydrogen peroxide—ferrous ion involved hydroxyl radicals. Kolthoff and Medalia,[3,4] in a study of oxidation of ethyl alcohol by the system, H_2O_2-Fe^{2+}, established that micro concentrations of inorganic and organic impurities in distilled water or the reagents used in the system gave rise to induced oxidation of ferrous ions. Simultaneously and independently the significance of such impurities in distilled water were recognised by Barb, Baxendale, George and Hargrave,[5] in the oxidation of leuco form of Aeronol brilliant Blue by the Fenton's reagent. In this connection, the work of Fricke and Hart[6,7] who showed long ago that the traces of organic impurities in distilled water could be quantitatively removed only by irradiation with X-rays may also be recalled. A qualitative evidence for the effect of organic impurities in the photochemical system, ion-pair complex, $Fe^{+3}X^-$-Vinyl Monomer, M, where X^- = OH^-, Cl^-, N_3^- etc. and M = acrylonitrile or methylmethacrylate or methacrylic acid, has been inferred in this paper.

EXPERIMENTAL AND RESULTS

When the system $Fe^{+3}X^-$-M, is irradiated with ultraviolet light of wavelength 300-400 mμ, the primary photochemical reaction is an electron transfer reaction involving reduction of the cation and oxidation of the anion to a free radical.[8,9] In a secondary reaction free radicals initiate polymerization of the substrate, vinyl monomer. A detailed kinetic study of polymerization with experimental details was presented by Evans, Santappa and Uri[10] and Santappa.[11] Experiments were mostly carried out with 313 mμ. The reaction system, $Fe^{+3}X^-$-M, in aqueous solution has been deaerated by nitrogen purified in Fieser's[12] solution. The intensity of light (I) was determined actinometrically using uranyl oxalate solution. The light absorption fraction, k, by the ion-pair species was determined spectrophotometrically. After irradiation of the system and filtration of the polymer, the rate of ferrous ion production (dFe^{+2}/dt) was determined colorimetrically using o-phenanthroline as the colouring and complexing agent.

It was observed that the systems, $Fe^{+3}OH^-$-M and $Fe^{+3}Cl^-$-M, gave constant quantum yields

for ferrous ion, 0·05, and 0·13 respectively with big or small concentrations of monomer. The quantum yields in these two cases did not decrease even in the absence of monomer. On the other hand, with the system, $Fe^{+3}N_3^-$-M, a linear variation of quantum yield for ferrous ion with monomer concentration and a maximum quantum yield of 0·5 for high concentrations of the monomer was observed (Fig. 1).
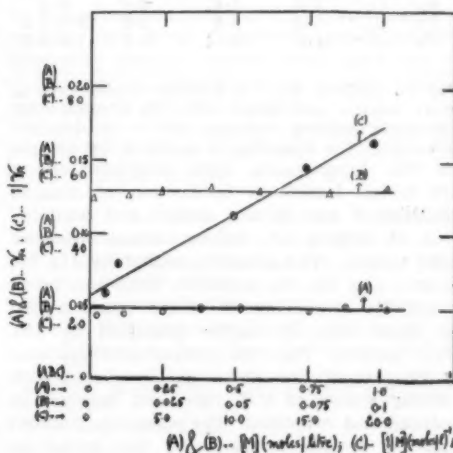

FIG. 1. Graph A represents the invariability of quantum yields for ferrous production (γ_{Fe}) with monomer concentration in the system $Fe^{+3}OH^-$-acrylo nitrile; Graph B represents the same invariability in the system $Fe^{+3}Cl^-$-methyl-methacrylate; Graph C represents variation of reciprocal quantum yield with reciprocal monomer concentration in the system $Fe^{+3}N_3^-$-acrylo-nitrile at pH = 1 to 11.

The sources from which impurities might be introduced into the reaction system are (1) Fieser's solution which is used to deoxygenate nitrogen which bubbled through the reaction cell. (2) The reagents like water, ferric perchlorate, perchloric acid, hydrochloric acid, sodium azide, etc., which are used in the system.

Three methods of deaeration indicated in Table I by (a), (b), (c) were tried and it is obvious from Table I that it makes a great difference in the rate of ferrous ion production between these methods. It was also observed that the rate of ferrous ion production was

unaffected by change of monomer concentration using either (b) or (c) type of deaeration.

TABLE I

Method of deaeration	Ion Pair	313 mμ ; $I = 1.2 \times 10^{-4}$ N$h\nu$/hr. $d\mathrm{Fe}^{+2}/dt$ (moles/hr.) $\times 10^6$		365 mμ ; $I = 7 \times 10^{-5}$ N$h\nu$/hr. $d\mathrm{Fe}^{+2}/dt$ (moles/hr.) $\times 10^6$	
		Monomer	No Monomer	Monomer	No Monomer
(a)	$\mathrm{Fe}^{+2}\ \mathrm{OH}^-$	1.75	1.2		
	$\mathrm{Fe}^{+3}\ \mathrm{Cl}^-$	3.1	2.0	1.7	1.4
(b)	$\mathrm{Fe}^{+2}\ \mathrm{OH}^-$	8.0	8.0	3.7	3.7
	$\mathrm{Fe}^{+3}\ \mathrm{Cl}^-$	1.6	1.6	9.0	9.0
(c)	$\mathrm{Fe}^{+2}\ \mathrm{OH}^-$	8.0	5-8	3.6	2.8-3.6
	$\mathrm{Fe}^{+3}\ \mathrm{Cl}^-$	14.0	12-14	8.2	7.6-8.2

(a) No distilled water or monomer solution between Fieser's solution and reaction cell. *(b)* Distilled water or monomer solution between Fieser's solution and reaction cell. *(c)* Degassing the system by high vacuum.

A few experiments were conducted along lines which facilitated destruction of organic impurities if any in the system and accumulation of ferrous ion, before adding monomer to the system. The solutions containing (1) the ion-pair, and (2) the monomer were first taken in separate compartments of the reaction system which was thoroughly deaerated by (b) or (c) method. Then the compartment containing ion-pair solution alone was irradiated with a strong source of U.V. light and ferrous ion produced was estimated. The monomer solution from the second compartment was added to the already irradiated ion-pair solution and the combined solution was further irradiated. From the total ferrous ion produced it was possible to calculate ferrous ion produced due to various concentrations of monomer (Table II).

TABLE II

Ion-Pair:$\mathrm{Fe}^{+3}\mathrm{Cl}^-$; $[\mathrm{Fe}^{+3}] = 10^{-3}$ M; $[\mathrm{HCl}] = 0.5$ N
Monomer = Methyl methacrylate

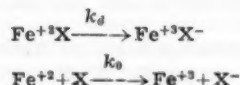| [M] Molar	Concentration $[\mathrm{Fe}^{+2}] \times 10^4$		
	Accumulated before adding monomer	Total after adding monomer	due to monomer
0.1	0.87	3.16	2.28
0.1	3.42	3.75	0.33
0.1	2.06	2.73	0.67
0.01	2	3.56	1.56
0.001	1.26	4.0	2.74
0	0.5	0.575	0.075

It is seen from Table II that the results were not reproducible for the same concentration of the monomer nor is there any regularity in variation of ferrous ion produced with the change in monomer concentration. The only difference in experimental conditions was that different samples of distilled water were used for each experiment. Various types of distilled water, *e.g.,* (a) chemically pure water distilled over KMnO_4 and used after a fortnight; (b) water distilled over KMnO_4 and used immediately; and (c) conductivity water, were then used in the system, Fe^{+3} Cl-methylmethacrylate, which was irradiated under identical conditions. These gave different values for the rates of ferrous ion production.

DISCUSSION

Assuming stationary concentrations for free radicals which initiate and propagate polymerization (k_i is the rate constant for initiation) one can obtain the following expression for the rate of ferrous ion production,
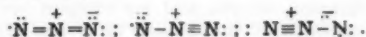
$$\frac{d\mathrm{Fe}^{+2}}{dt} = \frac{k_s k_e \mathrm{I}}{k_d + k_s} \left(\frac{k_i\,[\mathrm{M}]}{k_0\,[\mathrm{Fe}^{+2}] + k_i\,[\mathrm{M}]} \right)$$

where k_s is the rate constant for separation of $\mathrm{Fe}^{+3}\mathrm{X}$ into $\mathrm{Fe}^{+2} + \mathrm{X}$; k_d and k_0 are constants for the following primary and secondary dark back reactions respectively. I is the intensity of light.

$$\mathrm{Fe}^{+3}\mathrm{X} \xrightarrow{k_d} \mathrm{Fe}^{+3}\mathrm{X}^-$$

$$\mathrm{Fe}^{+2} + \mathrm{X} \xrightarrow{k_0} \mathrm{Fe}^{+3} + \mathrm{X}^-$$

The net quantum yield for ferrous ion production should linearly vary with concentration of the monomer attaining a maximum value represented by $k_s/(k_s + k_d)$ for high concentrations of monomer when $k_i\,[\mathrm{M}] \gg k_0\,[\mathrm{Fe}^{+2}]$. One possible explanation that suggests itself for the constant quantum yields of ferrous ion with $\mathrm{Fe}^{+3}\mathrm{OH}^-$ and $\mathrm{Fe}^{+3}\mathrm{Cl}^-$ ion-pairs even in the absence of any monomer, is that organic impurities in the system react with hydroxyl or chloride radicals and thus prevent dark back reactions. The assumption of existence of impurities seems justified because varying quantum yields were obtained with different samples of distilled and conductivity waters under identical experimental conditions. The impurities in other reagents in the system, ferric perchlorate, perchloric acid, and hydrochloric acid may also cause these discrepancies. All the reagents, however, have been tested to be free from any oxidising or reducing impurities. On the other hand, by using same sample of water for any set of experiments and using maximum concentration of

monomer it was possible to reduce the interference of the impurities to the minimum. That the azide radicals appear to be particularly stable towards these impurities might be understood by their resonance stabilization among the structures,
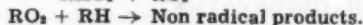
$$\ddot{\cdot}\overset{+}{N}=\overset{+}{N}=\overset{=}{N}\colon\ ;\ \overset{\cdot\cdot}{N}-\overset{+}{N}\equiv N\colon\ ;\ \colon\ \overset{+}{N}\equiv N-\overset{-}{N}\colon\ .$$

In the absence of monomer, hydroxyl or chloride radicals might be removed from the system by their reaction with impurities, say RH_2,

$$RH_2 + OH \text{---}\rightarrow RH + HOH$$

The radicals (RH) formed from impurities may involve in oxidative reactions by either (i) electron transfer reactions, $RH + Fe^{+2}\rightarrow RH^- + Fe^{+3}$ or (ii) abstraction of hydrogen atoms as indicated for OH radicals above. If electron affinity of the radical RH is high enough, electron transfer oxidation will be preferred whilst a high ionic bond dissociation energy for RH...H favours the oxidation by abstraction of hydrogen atom. If the radicals formed from impurities and those produced from the ion-pair complex are of the same order of electron affinity, then there will be same heat change and equal extents of their reaction with ferrous ion. On the other hand, if the bond dissociation energy OH..H is much greater than RH...H then the following reaction occurs :

$$RHH + OH \rightarrow HOH + RH$$

and the difference in the bond dissociation energies is reflected in the exothermicity of the reaction. Another possible way of removal of OH radicals from the system may involve trace of oxygen;

$$RH_2 + OH \rightarrow RH + HOH$$
$$RH + O_2 \rightarrow RHO_2 + RO_2$$
$$RO_2 + RH_2 \rightarrow RHO_2 + RH$$
$$RHO_2 \rightarrow RO_2$$
$$RO_2 + RH \rightarrow \text{Non radical products.}$$

Yet a third possibility of reactions of radicals from impurities may be conceived as represented by the following steps :

$$RH + Fe^{+3} \rightarrow RH^+ + Fe^{+2}$$
$$RH + Fe^{+3}OH^- \rightarrow HROH + Fe^{+2}$$

Whether the hydroxyl or chloride radicals would give rise to radicals which would photosensitize illuminated ferric salts and photodecompose water at the intensities used, it is not possible to say with certainty though this might be a useful field for investigation.

Many more possible ways of inter-reactions of radicals and ions obtaining in the system might be proposed depending upon the type of impurity present. A fruitful field in this direction is to get quantitative data on the nature of impurities, the electron affinities of radicals and the ionic bond dissociation energies of the impurities present before more light can be thrown on the reactivities of radicals towards impurities in aqueous solution.

The author is greatly indebted to late Prof. M. G. Evans of Manchester University who first stimulated interest in this work.

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INTERNATIONAL SYMPOSIUM ON MACROMOLECULAR CHEMISTRY

A SYMPOSIUM on macromolecular chemistry is to be held during September 27 to October 3, 1954, in Milano and Torino (Italy) under the auspices of the Commission of Macromolecular Chemistry of the International Union of Pure and Applied Chemistry (IUPAC). The subjects for discussion at the symposium are : (1) Building reactions of macromolecules; (2) Transformation reaction of macromolecules; (3) Block polymers and graft polymers, preparation and properties ; (4) Characterization of synthetic and natural polymers in relation to their practical application : (a) Molecular weight and molecular weight distribution ; (b) Branching and cross-linking; (c) Crystallisation. Application to read papers at the symposium should be made before May 31 to Prof. Giulio Natta, Instituto Chemica Industriale Politenico Piazza Leonardo da Vinci 32, Milano (Subjects 1-3), and to Prof. Antonio Nasini, Istituto Chimico Universita Corso Massimo D'Azeglio 48, Torino (Subject 4).

HIGH ALTITUDE ROCKET RESEARCH*

THE liquid-fuelled rocket came spectacularly before the attention of the public towards the close of World War II when the Germans bombarded London from Holland. At the end of the War, the U.S. Army captured about a hundred of these V_2 rockets. A large number of them were later used to serve as vehicles to carry instruments up into the high atmosphere for upper air research. Since 1946, other rockets have been developed. The present book by Mr. Newell gives an authoritative review of the research work done in the U.S.A. by various co-operating agencies with the aid of the power-driven rocket. The greatest height so far reached by an instrument-carrying rocket is 389 km., which was attained by a small rocket (WAC Corporal) launched from the nose of a flying V_2 rocket.

The development of the rocket as a research tool is an achievement of the first order in the field of upper air research. Let us forget for the time being its war-time uses. Many important phenomena which are observable in the atmosphere, and whose causes were guessed at, or inferred by recondite reasoning, have been cleared up without any obscurity. New facts have been discovered. All this has greatly stimulated thinking about the outer regions of the airy mantle of the earth, and some scientists are even looking forward with confidence to the day when the rocket will be fired out sufficiently far to become a satellite of the earth or land on the surface of the moon or Mars.

Some of the rockets are quite substantial bodies. For example, the V_2 rocket is 47' long

* By Homer E. Newell, *Jr.*, Academic Press Inc., 1953, pp. xiv + 298, Price $ 7·50.

and 5½' in diameter. It has space for 44 c.ft. of instruments. Most of the information collected by the instruments are automatically telemetered down to earth by radio signals. Photographic records and air samples are carried down with the rocket to a pre-adjusted height above ground, at which the rocket is made to burst and the released records come down to earth with a parachute.

After an introductory chapter, the author devotes the next two chapters to a detailed description of the rocket and the arrangements for collecting information and recording or telemetering them. The next six chapters he devotes to giving a scientific account of the problems that have been, or are being, investigated with the help of the rocket. These include measurements of pressures, densities, temperatures and winds in the upper atmosphere, of solar radiation in the ultraviolet and soft X-ray regions with spectrographs and photon counters, of atmospheric ozone and its distribution, of the charge densities and strengths of magnetic field in the ionosphere and of some of the properties of cosmic rays before they are transformed, scattered and enfeebled by the earth's atmosphere.

Mr. Newell has a fascinating story to recount and his book on High Altitude Rocket Research is an excellent, authoritative and readable summary of the scientific work that has been carried out by many groups of workers in this borderland between Atmospheric Physics and Astrophysics. Each chapter has a full list of references and the book is provided with both name and subject indices.

K. R. RAMANATHAN.

GULMARG RESEARCH OBSERVATORY

THE Gulmarg Research Observatory was formally declared open by Prof. A. H. Compton, Chancellor of Washington University, on April 4, 1954. In the course of his address on the occasion, Prof. Compton observed that the altitude of the observatory (9,000') is comparable with most of the high altitude laboratories elsewhere with which it is important to compare results, *e.g.*, Mexico City (about the same magnetic latitude) at 7,500', Huancayo, Peru, at 10,500' Echo Lake, Colorado at 10,000', and Jungfraujoch, Switzerland at 11,300'. The location is also suitable as a base station for work at higher altitudes, up to 11,000' Khillan Marg, 1 hour distant, and up to

14,000' at Apharvat, 3 hours distant. These locations are as high as any station at which high altitude research is now regularly being done.

The establishment of such a high altitude observatory where it can be operated by Indian scientists is of especial importance in providing an opportunity for significant contributions to the advance of science and for training competent scientists. He added that Indian science and in particular the Universities of Aligarh and of Jammu and Kashmir are fortunate to have this laboratory which is an asset to India and to the scientific world.

LETTERS TO THE EDITOR

PHOTOELASTIC BEHAVIOUR OF AMMONIUM CHLORIDE

THE photo-elastic behaviour of some cubic crystals was critically examined by Mueller.[2] He found that TlCl, NaCl, CsCl and KCl are different from one another in regard to their photoelastic properties. Unlike several other cubic crystals, NH_4Cl presents an interesting example in its lattice structure. Below the transition temperature, it belongs to CsCl group and above that temperature, it changes to NaCl group.

The author's experimental work has given the following values of the piezo-optic and elasto-optic constants of NH_4Cl (for $\lambda = 5893$ Å).

$$(q_{11} - q_{12}) = -3 \cdot 06 \times 10^{-13}; \quad q_{44} = 3 \cdot 63 \times 10^{-13};$$
$$q_{11} = 1 \cdot 91 \times 10^{-13}; \quad q_{12} = 4 \cdot 89 \times 10^{-13}.$$
$$(p_{11} - p_{12}) = -9 \cdot 73 \times 10^{-2}; \quad p_{44} = 2 \cdot 47 \times 10^{-3};$$
$$p_{11} = 14 \cdot 49 \times 10^{-2}; \quad p_{12} = 23 \cdot 97 \times 10^{-2}.$$

At laboratory temperature, NH_4Cl thus behaves as a negative uniaxial crystal when stressed along a cube axis ($p_{11} - p_{12} = -0 \cdot 097$). When stressed along a cube diagonal, it becomes a positive uniaxial crystal ($p_{44} = 0 \cdot 25$). This is what is to be expected because it belongs to the CsCl group. Since the structure of NH_4Cl changes to NaCl group above the transition temperature, it will be interesting to see if ($p_{11} - p_{12}$) continues to be negative while p_{44} also becomes negative.

For ammonium chloride, when a stress is applied along $[\bar{2}11]$ and the direction of observation is along $[01\bar{1}]$ the axes of bifringence make an angle θ with the stress axes (Bhagavantam[1]), given by the relation

$$\tan 2\theta = 2\sqrt{2}(A - q_{44})/(A + 5q_{44}),$$

where $A = (q_{11} - q_{12})$.

This result has been verified experimentally and the observed value of θ is 22°, in close agreement with the value calculated from the experimentally determined values of the stress-optic constants.

Another observation made in the course of the present investigation is that for stresses beyond 0.5 kg./mm.^{2} along any direction other than a cube edge, single crystals of ammonium chloride become plastic and show residual birefringence even after the stress is removed.

A full report of the investigations will be published elsewhere in due course.

The author's grateful thanks are due to Dr. S. Bhagavantam for his kind interest in the work.

Physical Labs.,　　　　　T. S. NARASIMHAMURTY.
Osmania University,
Hyderabad-Deccan-7,
March 5, 1954.

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SOME NUCLEAR MODELS FOR HIGH ENERGY ELECTRON SCATTERING

RECENTLY, the experimental differential scattering cross-sections for the nuclear scattering of 150 Mev. electrons by tantalum and 125 Mev electrons by gold and lead have been obtained by Hofstadter, Fechter, and McIntyre[1] To correlate this data, the following nuclear density distributions have been proposed by Schiff[2]:—

$$\rho_1(r) = \bar{\rho}_1 exp\,[-(r/a_1)^2] \tag{1}$$
$$\rho_2(r) = \bar{\rho}_2 a_2^4/(a_2^2 + r^2)^2 \tag{2}$$
$$\rho_3(r) = \bar{\rho}_3 exp\,[-r/a_3] \tag{3}$$
$$\rho_4(r) = \bar{\rho}_4\,[1 + (r/a_4)\,exp\,[-r/a_4] \tag{4}$$

Schiff has obtained the most appropriate parameters for these models from the point of view of the above electron scattering. He has also calculated the electrostatic energy for such charge distributions. One can discard the first two models because they give about twice the required value for this energy. However, the remaining two models give this energy only a few per cent. higher than the required value. These models, therefore, require further consideration.

On the basis of a correlation between the nuclear shell numbers and the nuclear density proposed by Born and Yang,[3] one obtains for the neutron or proton shell numbers

$$N_l = A\,(1 + 3/2)^3/3\pi^2 r_m^3 \rho\,(r_m)$$

where r_m is the value of r where $r^3 \rho(r)$ is a maximum. The empirical shell numbers are obtained provided one takes $r_m^3 \rho(r_m)/A = 0.112$. We have used this criterion to test the suitability of the remaining two models.

On normalisation we have

$$8\pi\bar{\rho}_3 a_3^3 = A;\;\; 32\pi\bar{\rho}_4 a_4^3 = A$$

and using these conditions we obtain

$$r_m^3 \rho_3\,(r_m)/A = 0.053$$
$$r_m^3 \rho_4\,(r_m)/A = 0.059.$$

These values are independent of the respective parameters of the two models.

On the basis of the above considerations, it is concluded that these models also are unsuitable. Similar investigations on other nuclear models are now in progress, the results of which will be published later.

M. G. Science Institute,　　　　N. J. PATEL.
Navarangpura,　　　　　　　　K. M. GATHA.
Ahmedabad-9, *March* 13, 1954.

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EMPIRICAL RELATION FOR A VIBRATION FREQUENCY OF MONO-DERIVATIVES OF BENZENE

IN the mono-derivatives of benzene, the vibration $\nu_{18}e_{2g}$ (606) of benzene splits into an a_1 component and a b_1 component. In the ground state the a_1 component has been represented[1] by a simple formula involving only the mass of the substituent. The b_1 component is known[1-9] to be in the neighbourhood of 615 cm.$^{-1}$ In the first excited singlet electronic level, which corresponds to the $^1B_{2u}$ level of benzene, the b_1 component is known[1-9] to be in the neighbourhood of 520 cm.$^{-1}$ and the a_1 component ($'\nu'_{18}a_1$) can be represented by the following empirically derived relation analogous to the one for the ground state,

$$'\nu'_{18}a_1 = 1782\,[(1/X) + (1/78)]^{\frac{1}{2}}\;cm.^{-1}$$

where X is the weight of the substituent (on atmoic weight scale). The relation holds for $X \geqslant 15$. The ratio of the corresponding factors

in the two formulæ, *i.e.*, $(1782/1980) = 0 \cdot 9$, shows that the frequency of the a_1 component in the excited state is about nine-tenths of that in the ground state. A comparison of calculated values with observed ones is shown in Table I.

TABLE I

Comparison of calculated and observed values of
$'\nu'_{18}a_1$

Molecule	Weight of X	$'\nu'_{18} a_1$	
		Cal.	Obs.
Toluene[2]	..	15	502	456
Aniline[3]	..	16	489	492
Phenol[4]	..	17	477	475
Fluorobenzene[5]	..	19	455	451
Benzonitrile[6]	..	26	403	406
Benzaldehyde[7,8]	..	29	388	400
Chlorobenzene[9]	..	35	363	372

Dept. of Spectroscopy,   SATYA NARAIN GARG.
Banaras Hindu University,
October 27, 1953.

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HEAVY MINERALS OF CHARNOCKITES AND LEPTYNITES

THE importance of the study of the accessories of igneous and allied rocks has been dealt with and illustrated in a series of interesting papers by Groves,[1] Taylor[2] and Reed,[3] among others.

The heavy minerals of four charnockites (two basic, and one each of the intermediate and acid varieties) and two leptynites from the hills near Padmanabham, about 10 miles from Bhimilipatam in Visakhapatnam District, have been studied following mainly the methods suggested by Groves.[1] Sphene, not found in the thin sections of the respective rocks, has been observed in the heavy mineral mounts of the basic and acid charnockites and the leptynites. The occurrence of grains of sillimanite and monazite in the heavies of the leptynites is also noteworthy.

The percentages of the various minerals in the different rock specimens studied, together with their index figures (the percentage of the total heavies in the respective samples) are given in Table I.

TABLE I

		Charnockites				Leptynites	
		Basic I	Basic II	Intermediate	Acid	I	II
Index figure	..	51·3	55·5	36·8	23·6	28·7	26·9
Zircon	..	2·0	1·7	3·0	6·3	4·7	6·0
Apatite	..	1·3	1·7	7·3	4·7	3·0	3·3
Sphene	..	1·7	1·3	..	2·7	3·3	3·7
Monazite	..	..	..	..	..	2·0	2·3
Hypersthene	..	44·0	45·0	58·0	75·3	27·7	36·0
Hornblende	..	11·3	19·3	..	..	..	..
Diopside	..	28·7	23·3	..	..	..	..
Garnet	..	..	..	25·3	6·3	32·2	25·7
Sillimanite	..	..	..	..	..	6·9	5·7
Biotite	..	2·0	2·3	4·7	2·7	11·3	8·7
Opaque ore minerals	..	9·0	5·4	1·7	2·0	8·9	8·6

It is seen that in the charnockites, there is a general decrease of the 'true' accessories towards the basic end, and that the index figures increase with increasing basicity. The leptynites are characterised by a general abundance of the 'true' accessories, and they have the highest percentage of sphene and biotite. According to Groves,[4] the production of these two minerals, in most cases, is increased by assimilation.

Among other features observed are: (1) equidimensional grains are rare; (2) the stout prismatic and the long prismatic grains are more common in the basic rocks, while the short varieties are of frequent occurrence in the intermediate and acid rocks; (3) some grains of the 'true' accessories in the intermediate and acid rocks have corroded margins, while this character is more common with those of the leptynites.

From the observations, the following corroborative assumptions are suggested:

(1) The occurrence of garnets and grains of 'true' accessories with corroded margins in the acid and intermediate charnockites and their absence in the basic type is in accordance with the concept that basic charnockites are magmatic in origin while the intermediate and acid varieties are not pure differentiation products, but have assimilated, in part, the country rock (Khondalites). (2) The presence of sillimanite and the common corroded borders of zircon, apatite and sphene grains in the leptynites,

probably point to their hybrid and interacted nature.

It is significant that the monazites are exclusively confined to the leptynites and are absent from the charnockites. Mahadevan and Sathapathi[5] have suggested the pegmatites cutting through the khondalites as the home of monazite in Visakhapatnam area. In this context, the above results are interesting.

I thank Professor C. Mahadevan for his kind interest in these investigations.

Dept. of Geology,   C. SRINIVASA SASTRY.
Andhra University,
Waltair, *February* 4, 1954.

1. Groves, A. W., *Geol. Mag.*, 1927, **64**, 241 & 457.
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FOSSIL HOLOTHUROIDEA FROM THE TRICHINOPOLY CRETACEOUS (S. INDIA)

EARLIER micropalæontological studies[1-4] of the Trichinopoly Cretaceous rocks have stressed their great interest and importance both from the stratigraphic and palæontologic viewpoint. Apart from these, further reports on the fossil algæ are in the press. The latter, when published, are likely to throw light on the evolution of Coralline algæ as commented by Professor Johnson of Colarado School of Mines.

Much more interesting than the facts referred to above, is the occurrence of recognisable remains which are determined as the fossils of Holothuroidea. Their study has led to the conclusion that such fossil remains from this area will help materially in recognising the holothurians. In this region, these objects "are confined to narrow vertical ranges" since rocks from different stratigraphic units have yielded different forms in the Trichinopoly area. In identifying these forms, the paper by Cronies and McCormack[5] has been of great help to the author. Fig. 1 is a longitudinal section of *Ancistrum* which is recognised only by the "fishhook-like" spicules. The generic description given by Cronies for *Ancistrum* leaves no doubt about the identity of the form. Fig. 2 is another form of the same genus, while Fig. 3 represents a c-shaped body which is considered as a fossil of Holothuroidea by Cronies. Fig. 4 is a trans-

verse section of *Lœtmophasma*, which genus is founded only on the wheel-shaped types. This form represents a stage in the development of such wheel-like plates. All the forms mentioned above come from the Limestone found at Terany.

1 × 100   2 × 100

3 × 100   4 × 100
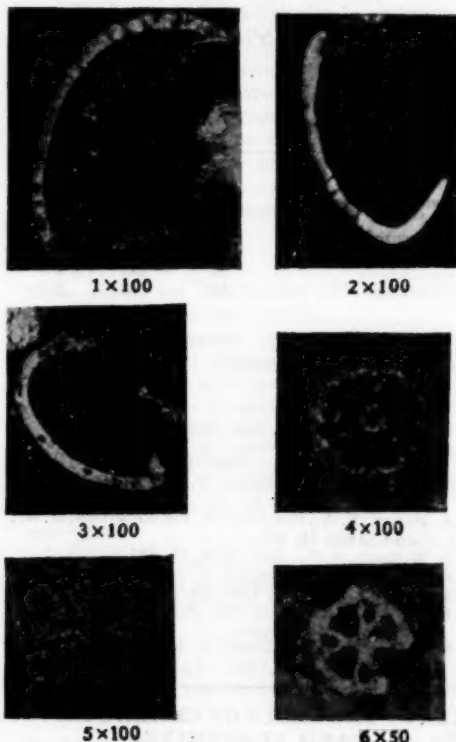
5 × 100   6 × 50

Fig. 6 is a transverse section of *Mesothuria*, a "table" form, which may be either tri- or quadri-radiate. The form shown in the figure is a quadri-radiate type with four large and three smaller radials. The rim of the disc is very well preserved. This form is observed in the Limestone found at Cullygoody.

Fig. 7 is a transverse section of *Zygothuria* which is also an exclusively tri- or quadri-radiate form; the form seen in this figure has only five radials preserved. This form is noticed in the Niniyur cherts of Yellakudumber area.

Fig. 8 shows the very beautiful form, *Myriotrochus*, with the fine arrangement of spokes alternating with "teeth" which are large, flat and project horizontally inward from the rim. The Limestone at Terany has yielded this form.
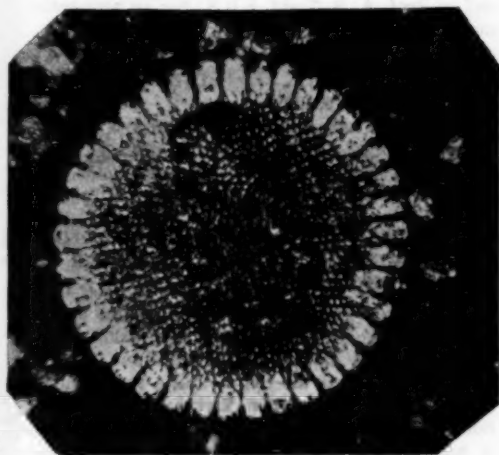
7 × 100   8 × 100   9 × 100

Fig. 9 shows a very finely preserved calcareous body which is determined as the fossil of holothuroidea because of the radial arrangement of spokes or radials which do not show any trace of connection with the central cavity, like the branches of Calcareous Siphoneæ do. This wheel-like body is referred, provisionally, to *Chiridota*. This is seen in the Limestone of Naicolum area.

10 × 50

Fig. 10 shows the most abundant and attractive form in the material under study. This is a very fine representative of similar, but specifically different, forms that occur in the different stratigraphic units of Trichinopoly area, though the figured specimen does not show the central perforations. Before being assigned to any one of the three genera—*Protocaudina, Chiridota* and *Lœtmosphasma*, such forms should be re-examined in view of the critical statement by Cronies (p. 138) that "spicules which might possibly be confused with *P. traquairii* have not yet been reported from either the Mesozoic or Cenozoic sediments". So the value of the study of such forms is increased.

An attempt is made, for the first time in India, to study such fossil remains and to assign them to the Holothuroidea, as others have done outside India. As Cronies predicted long back, they occur in a "number of the Cretaceous formations" in this area.

Dept. of Geology,   S. S. GOWDA.
Central College, Bangalore-1,
February 27, 1954.

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GIBLING'S CORRECTION

GIBLING[1,2] has shown that since the interference corrections for $C\langle{}^C_C$ and $C\langle{}^C_O$ are 2·2 and 2·6 respectively, the interference correction for $C\langle{}^C_N$ will be 2·4.

The author has made a rational approach for the calculation of the interference corrections as adopted by Gibling[3] for the calculation of

the interference correction for $C\overset{\displaystyle C}{\underset{\displaystyle C}{<}}$. The group

parachor values for the groups containing C-NH₂ and C-OH are calculated from the mean parachor values of aliphatic amines and alcohols, determined by various workers in the field.[4-8] The values are presented in Table I.

TABLE I

Group or compound	X = NH₂		X = OH	
	Parachor	Difference	Parachor	Difference
CH₃X	97·5	..	88·0	..
(C)CH₂X	82·1	15·4	72·6	15·4
(C)₂CHX	64·5	17·6	55·0	17·6
(C)₃CX	44·7	19·8	35·2	19·8

These results indicate that the interference

corrections for $C\overset{\displaystyle C}{\underset{\displaystyle C}{<}}$, $C\overset{\displaystyle C}{\underset{\displaystyle N}{<}}$ and $C\overset{\displaystyle C}{\underset{\displaystyle O}{<}}$, as deter-

mined from the parachor values of aliphatic hydrocarbons, amines and alcohols appear to be the same, i.e., 2·2, if the parachor value of hydrogen is taken as 13·2.[3]

Details of the results will be published elsewhere.

The author is grateful to Dr. M. D. Avasare for his kind interest in the work.

Chemistry Dept.,   A. M. TALATI.*
V. P. Mahavidyalaya,
Vallabh-Vidyanagar,
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* Present Address : Chemistry Department, S. J. Science Institute, Baroda.

NOOTKATIN FROM *CUPRESSUS TORULOSA*

C. torulosa is an important timber tree of North-Western Himalayas and its wood is considered to be highly durable. Fine shavings of the heart wood were first extracted with cold petroleum ether (b.p. 40-60°), subsequently with cold ether and finally with alcohol. A crystalline tropolone could be obtained from the ether and alcoholic extracts. These were concentrated, the concentrate extracted with aqueous sodium hydroxide and the alkaline extract subsequently acidified with hydrochloric acid. The solid product crystallised from boiling petroleum ether or alcohol as colourless stout rectangular prisms and melted at 94-95° C. The yield from the ether extract was 0·02 per cent. and from the alcoholic extract 0·18 per cent. of the air dry weight of wood. It gave a green copper complex from an ether solution, m.p. 240-42° C. [Found : C, 67·8; H, 7·0; CuO (ash) 15·3; C₃₀H₃₈O₄Cu requires C, 68·5; H, 7·3; CuO (ash) 15·1 per cent.] When treated with hydrogen peroxide (1 mole) in formic acid it gave the monoformate of nootkatin glycol, m.p. 170-71° C. All these properties agreed with those of nootkatin recorded by Erdtman and Harvey[1] who isolated it for the first time from *Chamaecyparis nootkatensis* occurring in Sweden and who also proposed a constitution[1] for this new tropolone More recently Corbett and Wright[2] recorded its isolation from the heartwood of *Cupressus macrocarpa* found in New Zealand.

Dept. of Chemistry,   V. K. AHLUWALIA.
University of Delhi,   T. R. SESHADRI.
Delhi, *February* 9, 1954.

1. Erdtman and Harvey, *Chem. and Ind.*, 1952, 1267.
2. Corbett and Wright, *Ibid.*, 1953, 1258.

INFLUENCE OF CARBON MONOXIDE CHEMISORPTION ON VAN DER WAALS ADSORPTION

IN computing the extent of "free" metal atoms on the surface of iron, cobalt and nickel catalysts, from their adsorption data for carbon monoxide at liquid air temperature, it is assumed that the chemisorbed layer of the gas is not removed by evacuation at − 78° C. and that it has the same capacity for van der Waals adsorption as the bare metal surface.[1,2] Stone and Tiley[3] reported that the chemisorption of carbon monoxide on copper oxide depressed its physical adsorption of krypton at − 183° C. whereas Joy and Dorling[4] experimenting with a promoted iron catalyst found that the existence of a film of chemisorbed carbon monoxide did not affect its adsorption of nitrogen at − 195° C. In view of this discrepancy concerning an important aspect of adsorption processes it was considered desirable to study

under similar conditions the behaviour of a series of kieselguhr-supported cobalt catalysts which have been prepared by us and are under investigation in this laboratory.

Two sets of experiments were performed with each of our catalysts. The first of these consisted briefly as follows: The catalyst was thoroughly reduced with hydrogen at 350°C. and evacuated at the same temperature for 8 hours and was then subjected to the following operations in succession in order to obtain data for the adsorption isotherms shown in Fig. 1:
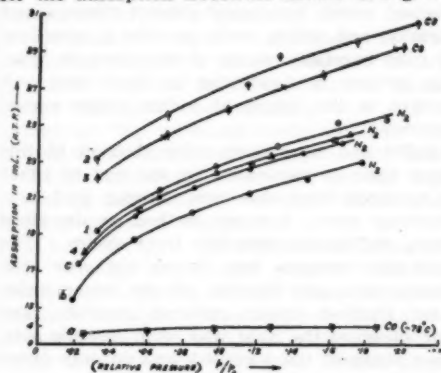

FIG. 1. Adsorption isotherms of nitrogen and of carbon monoxide on cobalt-thoria-magnesia-kiesel-guhr catalyst.

(1) Determination of nitrogen adsorption at − 191° C. (isotherm 1) after which the catalyst was evacuated at 10⁻⁵ mm. for 2 hours at 300° C.

(2) Determination of carbon monoxide adsorption at − 191° C. (isotherm 2) followed by evacuation at − 191° C. for 10 minutes and at − 78° C. for 2 hours.

(3) Repetition of the above run (isotherm 3).

(4) Determination of nitrogen adsorption at − 191° C. followed by evacuation at − 78° C. for 2 hours (isotherm 4).

(5) Determination of carbon monoxide adsorption at − 191° C. followed by evacuation at − 78° C. for 2 hours (isotherm 3, crosses).

(6) Determination of nitrogen adsorption at − 191° C. (isotherm 4, squares).

The catalyst was then evacuated for over an hour, raising the temperature gradually from − 191° C. to + 100° C., and treated with hydrogen at 350° C. for 24 hours. After evacuation at the same temperature for 8 hours, the adsorption experiments enumerated above were repeated in order to check reproducibility.

In the second set of experiments, the reduced and fully evacuated catalyst was treated with carbon monoxide at − 78° C. up to an equilibrium pressure of 38 cm. (isotherm *a*). It was then evacuated at the same temperature for 2 hours after which the adsorption of nitrogen was determined at − 191° C. (isotherm *b*). The surface was then cleared by evacuation for 2 hours at 300° C. and nitrogen adsorption isotherm determined again at − 191° C. (isotherm *c*). In both these sets of experiments, reproducible results were obtained with each catalyst sample. The data presented in Fig. 1 pertain to the catalyst cobalt-thoria-magnesia-kieselguhr (100 : 6 : 12 : 200), 1·84 g. of which were employed for the experiments.

Two conclusions can be drawn from a scrutiny of the isotherms shown in Fig. 1.

(1) The chemisorption of carbon monoxide at − 191° C. appears to be of two types one of which is much stronger than the other, the relatively weakly chemisorbed carbon monoxide being liberated by raising of temperature to − 78° C. and evacuation of the catalyst, whereas the more strongly chemisorbed gas is retained under the same conditions. This is revealed by the difference in the isotherms (3) and (1) and by (2) and (3) respectively. The quantity of the weakly chemisorbed gas is seen to amount to about 3 ml. whereas that of the strongly chemisorbed gas is about 1 ml. A similar result has been obtained by Joy and Dorling[4] on iron catalyst. The observations of Emmett and Brunauer that chemisorbed carbon monoxide is almost wholly retained under evacuation at − 78° C., therefore, seems to be of limited application.

(2) The physical adsorption of nitrogen is depressed in the presence of a film of chemisorbed carbon monoxide, each ml. of chemisorbed carbon monoxide lowering the nitrogen adsorption by about 0·6 ml. This is evident from the difference between isotherms (2) and (3) and the corresponding difference between isotherms (1) and (4). It is not known to what extent the weakly chemisorbed carbon monoxide lowers the nitrogen adsorption.

No reliable estimate of the extent of carbon monoxide chemisorption can, therefore, be made from these experiments with the cobalt catalysts employed. The difference between volumes of carbon monoxide and nitrogen adsorbed (isotherms 2 and 1) will give a low estimate and a similar comparison of the isotherms 2 and 3 would be still lower.

Further investigations of this problem are in progress and a detailed report will be published elsewhere.

The authors are thankful to Professor K. R. Krishnaswami for his kind interest and encouragement.

Dept. of General Chem.,   M. V. C. Sastri.*
Indian Inst. of Science,   V. Srinivasan.
Bangalore, *February* 20, 1954.

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SUGARCANE WAX

Cane wax is an important by-product of the sugar industry. In India where about 15 million tons of cane are crushed annually, the available wax would be about 12,000 tons valued at some crores of rupees.[1] This crude wax, however, has undesirable properties such as dark colour, stickiness, poor solvent take-up and retention and, hence, it cannot take the place of hard vegetable waxes of the carnauba type which are highly valued in industry. With a view to remedying these defects and utilizing this valuable raw material which at present is wasted, work was undertaken in 1950 at the National Chemical Laboratory on the bleaching and modification of the crude wax.

In view of contradictory reports as to the efficacy of different bleaching agents for the crude cane wax and its unusual resistance to bleaching,[2] a number of bleaching agents, such as bentonite and carbon,[3] chlorine,[4] sulfur dioxide,[5] potassium chlorate[6] and nitric acid,[7] were reinvestigated and a few new ones such as activated alumina, hydrogen peroxide, sodium peroxide, sodium hypochlorite and potassium dichromate were also examined. It was found that potassium dichromate with sulphuric acid was the best. Each pound of crude wax requires about 2·7 lb. of potassium dichromate. Chrome alum as a byproduct is obtained in about a 90 per cent. yield on the basis of the potassium dichromate consumed. This process of one-stage bleaching de-ashes the wax, removes its unsaturation and, under the experimental conditions, hydrolyses a part of the esters and oxidises the free alcohols so formed to the corresponding acids. The bleached wax, having the following constants, is obtained in about an 80 per cent. yield: m.p. 75-79° C.; acid value 125-30; ash content practically nil; saponification value 152; iodine value 1·8. This bleached wax can be sepa-

rated either by a chromatographic procedure or by the method described by Murray and Schoenfeld[8] into its acidic and ester fractions. It consists of 18 per cent. esters and about 80 per cent. acids. It is further chemically modified by esterifying with polyhydric alcohols such as ethylene glycol, when a light-coloured wax of m.p. 78-79° C. and acid value 20-25 is obtained. When this wax is mixed in a suitable proportion with the alkali soap or amides of the bleached wax prepared under carefully controlled conditions, compositions are obtained which have good solvent take-up and retention and which could provide a substitute for hard vegetable waxes of the carnauba type. This process was patented in April 1952 and brought to the notice of Indian sugar manufacturers.[9]

Hatt[10] and co-workers (the abstract of this paper came to our notice by the end of 1951) in Australia have also used chromic acid as a bleaching agent, but our method as described above, differs considerably from theirs. The Australian workers first de-ash the wax with mineral acid and distilled off the lower molecular fraction under reduced pressure, and then bleached the hard wax with chromic acid. They obtained the bleached wax in only about a 50 per cent. yield. As reported by us,[9] the first two stages are not necessary. Now, the Australian workers have come to the same conclusion.[11]

A complete account of this investigation and of the compositions of the crude wax and bleached waxes will appear elsewhere. The authors are grateful to Dr. R. C. Shah for his valuable suggestions during the progress of the work.

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CALCIUM UPTAKE BY COFFEE POWDER

DURING the course of our investigations on the effect of hardness of water on the cup quality of coffee, we observed that the flavour of coffee is not much influenced by the hardness or otherwise of the extracting water. Hard water, which as such was unacceptable as potable water, when used for brewing coffee, gave a decoction which was considered acceptable by the taste panel. This observation led us to the present investigation on the water-softening properties of coffee powder.

According to Rode[1,2] products with water-softening properties can be prepared by treating finely ground coffee with various reagents. More recently Ramakrishnan et al.,[3] have prepared an ion exchange material from coffee husks by treatment with sulphuric acid, sodium chloride and alum. No work on the water-softening properties of untreated coffee powder has so far been reported.

5 per cent. w/v brews of roasted coffee powder (Plantation A) were prepared using distilled water, sample of well water and calcium chloride solution. Calcium was estimated in the water samples used and in the ash obtained from the brews by ammonium oxalate precipitation and titration with $N/100$ $KMnO_4$. The spent coffee powder after extraction was dried, ashed and the calcium in it was determined to estimate the calcium uptake by powder. The results are given in Table I.

TABLE I

Calcium uptake by coffee powder during brewing

(5 g. powder + 100 ml. water)

| Brewing media | Calcium content (mg.) | | | |
	Coffee powder	Brewing medium	Decoction	Spent coffee powder
I Well water	5·84	18·48	11·36	12·96
II Well water + CaCl₂	5·84	21·76	12·96	13·96
III Distilled water	5·60	··	0·80	4·80

From the above table, it can be seen that coffee powder adsorbs calcium from the water used for brewing. The possible adsorption capacity of the coffee powder for other metals and fluorine as well as the nutritional implication of the metal binding property of coffee powder are under study.

Our thanks are due to Dr. V. Subrahmanyan for his kind interest in the work and to the Indian Coffee Board under whose auspices this work was conducted.

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A PHOTOELECTRIC METHOD FOR THE RAPID DETERMINATION OF MOISTURE IN BIOLOGICAL MATERIALS

IN the course of our investigations on the determination of moisture in dehydrated samples of fruit pulps, we had occasion to use a number of methods for the estimation of moisture so that we could have a quick method for the control of the dehydration process. Methods available so far, namely, drying at 70° C. in a vacuum oven, use of Fischer reagent, toluene distillation method, etc., are rather tedious or time-consuming. Since the rapidity of the method is a very important consideration in the control of the dehydration process of fruits and vegetables, the dichromate oxidation technique recommended by Launer and Tomimatsu[1] was studied to find out its suitability for the purpose. A modification of this procedure was found to yield results in a very short time. Thus, after oxidation of the organic substance in the material with dichromate and sulphuric acid, the resulting yellowish green colour of the solution is measured on a Klett Summerson Photoelectirc Colorimeter using the 66 mμ red filter. A standard curve is drawn connecting the weight of the material taken and the resulting reading on the colorimeter. This curve is reproducible in the case of any one material. It can be re-drawn on the basis of 100 per cent. dry material, by determining the moisture accurately in the sample taken by means of a standard reference method such as drying in vacuum at 70° C. for 6-7 hours. Making use of this standard curve, it is possible to determine the weight of dry matter content in the sample taken and thereby deduce its moisture content. The whole series of operations, including weighing of material, oxidation with dichromate and measurement of colour on the

colorimeter can be completed in about 10-15 minutes.

0·1-0·3 g. of the finely divided material is weighed and made into a fine slurry with a known small quantity of water (4-5 ml.) in the case of tough materials like dried mango pulp, etc. To this slurry 25 (or 50) ml. standard dichromate solution (1·835 N) followed by 40 ml. concentrated sulphuric acid are added and the beaker allowed to stand for about 3-5 minutes to complete the oxidation. A small portion of the reaction mixture in a test tube is then cooled quickly to room temperature under running water and its colour measured on the photoelectric colorimeter. The weight of dry matter corresponding to the colorimetric reading is read off from the standard curve.

The method was applied in the case of mango pulp and papaya pulp at different stages of the process of dehydration in a cabinet dryer. From the standard curves showing the relation between the dry weight of the material taken and the colorimeter reading, the dry matter content of the pulp was determined by interpolation. The values for moisture content compared well with those obtained by drying the corresponding lots of pulp in an electric oven at 55° C. for 72 hours (Table I). Using a set of six replicate samples for the estimation of moisture, the standard error of the mean of the colorimeter readings was found to be very low (e.g., 274 ± 1·49 and 262 ± 1·29 in two typical experiments) showing that the method is highly reproducible.

TABLE I

Determination of moisture in mango and papaya pulps during dehydration

Stage of drying	Mango pulp		Papaya pulp	
	Moisture per cent.		Moisture per cent.	
	By dichromate method	By oven method	By dichromate method	By oven method
I	66·9	68·9	80·0	81·5
II	36·8	38·0	72·6	70·4
III	18·0	18·4	41·4	39·1
IV	8·3	9·5	29·1	26·5

Preliminary experiments indicate that this method may be applicable in the case of materials rich in protein and sugar. Experiments are in progress to study the effect of interfering substances like sulphites, etc., on the accuracy of the method.

The authors' thanks are due to Dr. V. Subrahmanyan for his keen interest in this investigation.
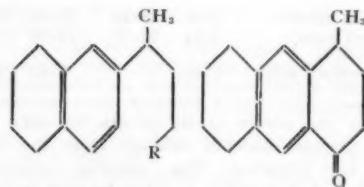
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CONVENIENT SYNTHESIS OF SOME ANTHRACENE DERIVATIVES

FRIEDEL-CRAFTS alkylation with unsaturated ketones and esters forms a novel and convenient route to polycyclic hydrocarbons.[1] This method was further extended to a study of the reactions of tetralin with ethyl allylacetate and allylacetone. In view of a recent publication of Mosby[2] which touches some of our common grounds, we place on record our observations in this regard.

Tetralin was reacted upon with ethyl allylacetate in the presence of aluminium chloride at 0-5° when the ester (I), b.p. 174-75°/8 mm. was obtained in 85 per cent. yield. The ester was quantitatively hydrolysed with alcoholic potash to the corresponding acid (II), b.p. 196-98°/6 mm., S-benzyl-isothiuronium salt, m.p. 124°. (Calculated for $C_{23}H_{30}O_2NS$: N, 7·03; Found: N, 6·75). This acid on cyclisation by Johnson's inverse process[3] gave the ketone (III), b.p. 175-77°/10 mm. in 80 per cent. yield; 2, 4-dinitrophenylhydrazone, m.p. 208° [Lit. (2) m.p. 209°]. (Calculated for $C_{21}H_{22}N_4O_4$: N, 14·21; Found: N, 14·10); Semicarbazone m.p. 203° [Lit. (2) m.p. 202-03°]. (Calculated for $C_{16}H_{21}N_3O$: N; 15·5; Found: N, 15·9). The ketone on reduction (Clemmensen) followed by dehydrogenation with palladised charcoal yielded 1-methyl anthracene (V); picrate (red needles), m.p. 114° [Lit. (4) m.p. 113-15°]. (Calculated for $C_{21}H_{15}O_7N_3$: N, 9·97; Found: N, 9·7).
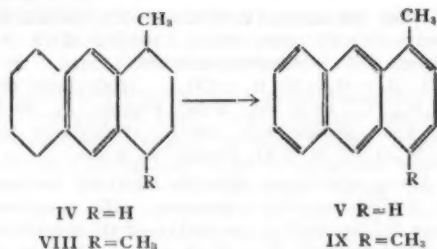

I R = COOC$_2$H$_5$
II R = COOH
VI R = CO—CH$_3$
VII R = HOCH—CH$_3$

III

IV R=H   V R=H

VIII R=CH₃   IX R=CH₃

Similarly tetralin was subjected to aluminium chloride catalysed reaction with allylacetone to furnish the ketone (VI), b.p. 190-92°/ mm. in 75 per cent. yield. It was reduced with sodium and moist ether to the carbinol (VII), b.p. 155-57°/4 mm. which was cyclised with concentrated sulphuric acid to the tetrahydro-anthracene derivative (VIII), b.p. 146-47°/4 mm. in satisfactory yield. Compound VIII was dehydrogenated to 1, 4-dimethylanthracene (IX) with palladised charcoal, picrate m.p. 140° [Lit. (2) m.p. 139-40°]. Microanalyses by Drs. Weiler and Strauss, Oxford.

The details will appear elsewhere.

Dept. of Chemistry,   VED. P. KUBBA.
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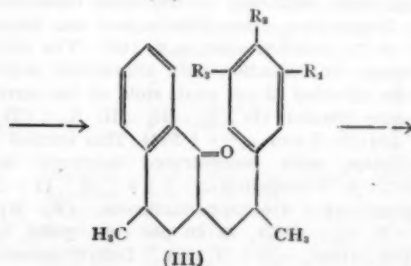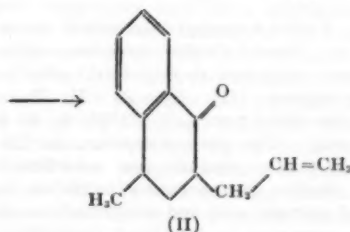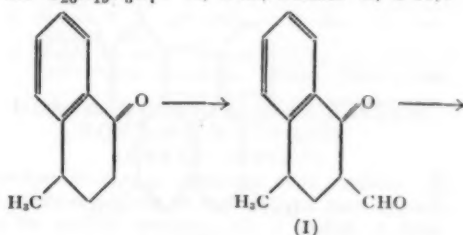Hoshiarpur,   S. M. MUKHERJI.
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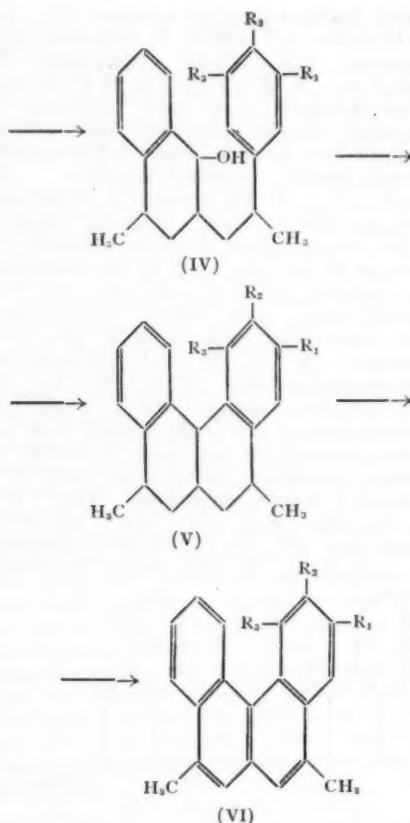4. Turner, *Ibid.*, 1950, **72**, 4318.

SYNTHESES OF 2:9-DIMETHYL-, 2:9:3-TRIMETHYL-, AND 2:9:2′: 4′-TETRAMETHYL-3:4-BENZPHENANTHRENE

EVER since Cook, Kennaway and their associates[1] demonstrated that 3:4-benzphenanthrene is a potent carcinogen, a number of synthetic routes to this hydrocarbon and its derivatives have been developed. One such method, developed by Mukherji, Gaind and Rao,[2] has now been extended further to the syntheses of certain polyalkyl-3 : 4-benzphenanthrenes.

4-Methyl-1-tetralone[3] was formylated[4] to obtain 2-hydroxy-methylene-4-methyl-1-tetralone (I) in 80 per cent. yield, b.p. 145-46°/6 mm This on allylation with allyl iodide, followed by hydrolysis[2] with 5 per cent. KOH at 50-55°,

yielded 2-allyl-4-methyl-1-tetralone (II), b.p. 140-42°/2 mm., η_D^{35} 1·5372, 2 : 4-Dinitrophenyl-hydrazone, m.p. 205-06° (Calculated for $C_{20}H_{20}N_4O_4$: N, 14·7; Found: N, 15·2). 2-Allyl-4-methyltetralone was then subjected to aluminium chloride catalysed[2] reaction with thiophene-free benzene, when 2-[β-methyl-β-(phenyl)-ethyl] 4-methyl-1-tetralon (III, $R_1 = R_2 = R_3 = H$) was obtained in 64 per cent. yield, b.p. 208-10°/1 mm. Ponndorf reduction of the above ketone proceeded smoothly to afford an 83 per cent. yield of the corresponding carbinol (IV, $R_1 = R_2 = R_3 = H$), b.p. 196-200°/2 mm. This carbinol on cyclisation with concentrated sulphuric acid[5] gave 2 : 9-dimethyl-1 : 2 : 9 : 10 : 11 : 12-hexahydro-3 : 4-benzphenanthrene (V; $R_1 = R_2 = R_3 = H$), in 85 per cent. yield, b.p. 206-10°/2 mm. Dehydrogenation of the latter product with palladium charcoal (30 per cent.) at 300-20° for 4 hours proceeded smoothly to yield 2 : 9-dimethyl-3 : 4-benzphenanthrene (VI; $R_1 = R_2 = R_3 = H$), m.p. 130° (Lit.[6] 130·6-31°), picrate, m.p. 162° (Lit.[6] 164·6-65°). (Calculated for $C_{20}H_{19}N_3O_7$: N, 8·66; Found: N, 8·60).

(I)

(II)

(III)

(IV)

(V)

(VI)

Similarly, 2-allyl-4-methyl-1-tetralone when subjected to Friedel-Crafts reaction with toluene, gave 2-[β-methyl-β-(p-tolyl)-ethyl]-4-methyl-1-tetralone (III; $R_1 = R_3 = H$; $R_2 = CH_3$), b.p. 198-202°/1 mm. η_D^{31} 1·5582, in 64·6 per cent. yield. The *para*-orientation in the above Friedel-Crafts product was established through its alkaline permanganate oxidation to a mixture of phthalic acid and terephthalic acid which were separated by fractional crystallisation from water. Terephthalic acid was identified as its dimethyl ester, m.p. 140°. The above tetralone, on reduction with aluminium isopropoxide afforded 83 per cent. yield of the corresponding tetralol (IV; $R_1 = R_3 = H$; $R_2 = CH_3$), b.p. 204-10°/3 mm., η_D^{33} 1·5544. This tetralol on cyclisation with concentrated sulphuric acid gave 2 : 9 : 3'-trimethyl-1 : 2 : 9 : 10 : 11 : 12-hexahydro-3 : 4-benzphenanthrene (V; $R_1 = R_3 = H$; $R_2 = CH_3$), in 80 per cent. yield, b.p. 200-02°/3 mm., $\eta_D^{33·6}$ 1·5734. Dehydrogenation

of this hexahydro derivative with palladium charcoal (30 per cent.) yielded 2 : 9 : 3'-trimethyl-3 : 4-benzphenanthrene, m.p. 91°. (VI; $R_1 = R_3 = H$; $R_2 = CH_3$). (Calculated for $C_{21}H_{18}$: C, 93·3; H, 6·66; Found: C, 92·7; H, 6·63; picrate m.p. 140°). (Calculated for $C_{27}H_{21}O_7N_3$; N, 8·41; Found: N, 8·25).

Again, aluminium chloride catalysed reaction of 2-allyl-4-methyl-1-tetralone with *m*-xylene gave 2-[β-methyl-β-(m-xylyl)-ethyl]-4-methyl-1-tetralone (III; $R_2 = H$; $R_1 = R_3 = CH_3$) in 62 per cent. yield, b.p. 218-22°/2 mm. The *meta*-orientation in this case was proved by the alkaline permanganate oxidation of the above tetralone to phthalic acid and trimesic acid which were separated due to the insolubility of trimesic acid in water. The trimethyl ester of trimesic acid melted at 142° (Lit.[7] m.p. 144°). Ponndorf reduction of the Friedel-Crafts product afforded 80 per cent. yield of the corresponding tetralol (IV; $R_2 = H$; $R_1 = R_3 = CH_3$), b.p. 210-12°/3 mm., $\eta_D^{34,8}$ 1·5563. Cyclisation of the above tetralol with concentrated sulphuric acid yielded 2 : 9 : 2' : 4'-tetramethyl-1 : 2 : 9 : 10 : 11 : 12-hexahydro-3 : 4-benzphenanthrene (V; $R_2 = H$; $R_1 = R_3 = CH_3$), b.p. 198-200°/2 mm., n^{33} 1·5738. The hexahydro derivative on dehydrogenation with palladium charcoal at 300-20° gave 2 : 9 : 2' : 4'-tetramethyl-3 : 4-benzphenanthrene (V; $R_2 = H$; $R_1 = R_3 = CH_3$), b.p. 200-05°/2 mm.; picrate, m.p. 150°. (Calculated for $C_{28}H_{23}O_7N_3$; N, 8·18; Found: N, 8·06).

Microanalyses by Drs. Weiler and Strauss, Oxford.

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OCCURRENCE AND BREEDING OF *PAMA PAMA* (HAMILTON) IN FRESHWATERS

FRY and fingerlings of *Pama pama* (Hamilton) were collected in fairly large numbers (about 564 specimens ranging in total length from 10–76 mm.) along with those of carps and cat-fishes in the fry collection nets, during the south-west monsoon months of 1951 and 1952 near Mokemah Ghat, Dighwara and Buxar on the Ganga and near Khagaria on the Burhi Gandak. Larger specimens of *P. pama*, 160–245 mm. in total length, were also recorded at Buxar in November and December 1952. This is perhaps the first record of the occurrence of *P. pama* in freshwaters far above the tidal influence.

According to Day[2] *P. pama* occurs in the Bay of Bengal entering estuaries and rivers as far as the tide extends. Weber and de Beaufort[5] state that its distribution extends from the Bengal-Orissa coast along Burma and Malaya to Sumatra. Recently Pantulu and Jones[4] describing larval stages of *P. pama* collected from the Hoogly near Barrackpore state that breeding takes place further down the river at the mouth of estuary or in the sea close to the estuary and that the juveniles are brought up by the tide. The post-larvæ and juveniles which are available in large numbers at Barrackpore are present only in small numbers in Shantipur area, which is about 170 miles from the sea.

Mokemah Ghat is situated about 470 miles from the sea and about 300 miles upstream from the Nabadwip-Purbastali area which forms the tidal limit of the Hoogly; Buxar is located still further upstream about 160 miles west of Mokemah Ghat and about 630 miles from the sea. The occurrence of the young and fairly big specimens of this species at places situated so far above the tidal limits of the Hoogly indicates that this fish has successfully acclimatised itself to freshwater conditions. The availability of the fry of this fish in the rivers Ganga and Burhi Gandak during the monsoon months indicates that the breeding time of this fish is the same as that of the majority of other riverine species of fish.

Another estuarine fish which breeds both under salt water and freshwater conditions is the pearl-spot, *Etroplus suratensis* (Bloch.), a brackish water perch indigenous to peninsular India and Ceylon. According to Hora[3] *E. suratensis* is a freshwater fish which has secondarily taken to brackish water. It has so well established itself in the new habitat that the main pearl-spot fishery in South India is in

brackish waters (Alikunhi *et al.*[1]). Some marine and estuarine fishes such as *Chanos chanos* (Forskal), *Lates calcarifer* (Bloch.), *Elops saurus* Linn., *Mugil* spp. are also known to thrive very well in freshwaters. Since *Pama pama* grows up to at least 5′ in length[2] and is now known to occur high up in the Ganga river, it may be worth exploring the possibility of culturing this species in freshwaters.

The occurrence of the fry of *P. pama* in large numbers in the river Ganga far above the tidal limits not only indicates that this fish has acclimatised itself to freshwater conditions but also breeds there.

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DOMINANT INHIBITORY FACTOR FOR AWNING IN RICE (*ORYZA SATIVA*)

AWNING in rice is dominant over awnless. In F_2, different kinds of segregations were recorded by earlier workers: (i) 3 awned : 1 awnless[2,3] signifying monogenic segregation; (ii) 9 awned : 7 awnless[1] indicating the operation of complementary factors; (iii) 15 awned : 1 awnless being the result of duplicate factors.[4,5] The present note describes the inheritance of awning involving dominant inhibitory factor.

C.28-16, an awnless *indica* from Burma was crossed with Aikoku, an awned *japonica* from Japan. The F_1 was awnless, contrary to expectation on the basis of earlier records. Three F_2 families were grown and the individuals classified into awned and awnless (Table I).

TABLE I

No. of the F_2 family		Awnless plants	Awned plants	Total	χ^2	Probability
I	Observed	66·0	8·0	74	3·083	>0·05
	Expected	60·1	13·9	74		
II	Observed	55·0	7·0	62	2·243	>0·05
	Expected	50·4	11·6	62		
III	Observed	80·0	9·0	89	4·370	>0·01
	Expected	72·7	16·7	89		<0·05

These families conform to a segregation of 13 awnless: 3 awned as would be expected in the presence of dominant inhibitor in one of the parents, in this case the *indica* parent. On this assumption, the genetic constitution of the two parents would be—C.28-16 *an an Ian Ian*, and Aikoku *An An ian ian*, where *Ian* stands for the presence of dominant inhibitory factor, *ian* for its absence, *An* stands for the presence of awn and *an* for its absence. The experiment was repeated for a second season and similar results were obtained.

The expression of awning in rice is much susceptible to environmental conditions. Although the various workers have inferred major gene action determining awning, they have observed certain gradations between different groups of awning indicating the operation of modifiers as well. The existence of dominant inhibitory factors besides the above complicates the inheritance of awning in rice.

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THE PHARYNGEAL POCKETS AND ITS ASSOCIATED STRUCTURES IN *GADUSIA CHAPRA* (HAM.)

Gadusia chapra is a plankton feeder, and its mouth is devoid of teeth. There are four pairs of gill arches, each bearing gill lamellæ on its outer surface and closely-set gill rakers on the inner surface. An additional row of rakers is present on either side of the floor of the pharynx.

There are two pharyngeal pockets which are being recorded in this fish for the first time. Each pocket is a diverticulum of the roof of pharynx and is like a curved horn. It has two parts: (*a*) the canal passage, and (*b*) the sac, the former continuing into the latter. The mesial rakers on the lower limb of the fourth gill arch and the additional row of rakers continue inside along the wall of canal passage. The sac portion of the pocket ends blindly and is devoid of rakers.

Each pocket is supported by and is attached to the epibranchial piece of the fourth gill arch. A cartilaginous extension arising from the epibranchial piece of the fourth gill arch encapsulates the pocket ventrally and partly dorsally.
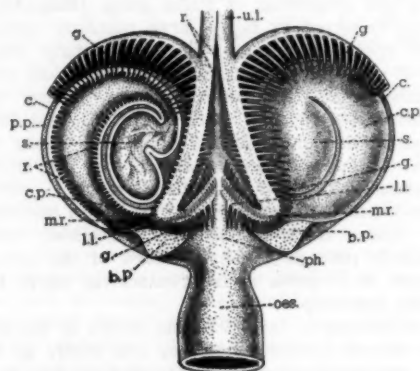

FIG. 1. Diagrammatic representation of the pharyngeal pockets of *Gadusia chapra* (Ham.) seen from the ventral side. Right pocket cut longitudinally to show the continuation of rakers along the wall of the canal passage.

b.p., bony plate; *c.*, cartilage; *c.p.*, canal passage of the pharyngeal pocket; *g.*, gills, *l.l.*, lower limb of fourth gill arch; *m.r.*, mesial rakers on the lower limb of fourth gill arch; *oes.*, œsophagus; *r.*, rakers; *p.p.*, pharyngeal pocket; *ph.*, roof of pharynx; *s.*, sac of the pharyngeal pocket; *u.l.*, upper limb of fourth gill arch.

The pharyngeal pocket has a folded stratified epithelial lining with plenty of mucous cells. A few taste buds are present only in mucosa of the canal passage. Mucosa is followed by submucosa which is made up of connective and adipose tissues. The muscularis is thick and striated, and blood capillaries are present in both the layers.

Hyrtl[1,2] first described the pharyngeal pockets in certain clupeoid fishes and termed these as *die accessorischen Kiemenorgane* or *die Kiemenschnecke*. Ridewood[5] recorded their existence in his work on the clupeoid osteology. Rauther,[4] in the study of accessory respiratory organs in bony fishes, mentioned more or less comparable structures in synbranchids, clupeoids and characinids. Lagler and Kraatz[3] described the pharyngeal pockets in *Dorosoma cepedianum*.

Regarding the function of these pockets, Hyrtl and Rauther have interpreted similar structure in related fishes, as of respiratory significance. Lagler and Kraatz describe the pockets in *Dorosoma* as non-glandular, non-vascular and consider these accessory to the digestive rather than to the respiratory system.

The pharyngeal pockets in *Gadusia*, however, are glandular, secrete mucus and are therefore to be regarded as accessory parts of the alimentary tract.

The pharynx leads into œsophagus which continues into the stomach. The pyloric region of stomach is developed into a gizzard which has a thick muscular wall and a cuticular lining. The gizzard is followed by the intestine and at its place of origin opens the bile duct. There are 100-120 pyloric cæca, which open through 15-25 orifices into the intestine. The intestine runs a circuitous course and terminates at the anus.

The author has also observed pharyngeal pockets in *Hilsa ilisha* (Ham.) and *Chanos chanos* (Forskal). Work on the anatomy and histology of pockets in these fishes is in progress and the observations will be published.

Sincere thanks are due to Dr. M. L. Bhatia for guidance and supervision in this work.

Dept. of Zoology,   B. G. KAPOOR.
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ELATERID GRUBS FROM *CUTANEOUS MYIASIS* IN GOAT

WHILE removing a number of Calliphorid (*Chrysomyia* sp.) maggots from a cutaneous ulcer between the hoofs of a goat at Karaikudi, the author came across a few long wiry grubs actively burrowing deeper and deeper into the living tissues, one of which (Fig. 1)

FIG. 1. Elaterid Grub from Cutaneous Myiasis.

was successfully isolated and identified as the larva of an *Elaterid* beetle.

This strange association of Elaterid larvæ with Calliphorid maggots is probably accidental. Still it is interesting to find that these larvæ which usually live in soil, dung and decaying vegetable matter or bore into wood, have adapted themselves to the new and strange

habitat remarkably well. One outstanding modification observed is the lack of sclerotisation and the consequent softness of the integument. The grub appears to be that of the common click beetle, *Agrypnus* sp.

Dept. of Zoology,   J. SAMUEL RAJ.
Alagappa College, Karaikudi,
March 6, 1954.

GAMETOPHYTES OF *VITIS PALLIDA* (W & A.)

Vitis pallida is a member of the family Ampelideæ (Vitaceæ). Literature regarding the embryology of vitaceæ is very meagre. Mulay, Nair and Sastry[1] have referred to the relevant literature on this subject. *Vitis pallida* is a tendril climber found frequently in the hilly tracks of the Western Ghats. The material for the present work was collected from Changanacherry (T. C. State) in the month of July 1953 and the following observations were made by the authors.

The development of the floral organs takes place in the sequence—sepals, petals, androecium and gynœcium.

A group of hypodermal archesporial cells appear in the young anther. The mature anther wall comprises the epidermis, fibrous endothecium, ephemeral middle layers, and secretory multinucleate tapetum. Reduction divisions are simultaneous. Cytokinesis occurs by furrowing and the microspore tetrads may be tetrahedral, isobilateral, or decussate. Pollen grains are shed at the three-celled stage (Fig. 1). They are triporate and are of the psilate type.

FIG. 1. T.S. of Pollen grain, × 725.
FIG. 2. Mature embryo sac, × 725.
FIG. 3. Two embryo sacs in the same ovule, × 725.

The ovules are bitegmic crassinucellate and anatropous. The micropyle is directed downwards. The deep-seated megaspore mother cell undergoes the usual meiotic divisions to form

a linear tetrad of megaspores of which the chalazzal one functions. Occasionally ovules with two megaspore mother cells also occur. The embryo sac passes rapidly through the 2, 4 and 8 nucleate stages. The apical end of the embryo sac after disorganising the nucellus comes out through the micropyle, extends beyond the ovule, and occupies the little space between the ovule and ovary wall, pressing itself closely to them. The apical end is seen to have penetrated into the abutting epidermal cells of the carpellary wall (Fig. 2). The position of the embryo sac, its thin wall, and the rich contents of the abutting epidermis clearly suggests a nutritive relation. Though protruding embryo sacs have been reported as occurring in many plants, such a condition is very rare in angiosperms.

In one case two mature embryo sacs have been observed to lie side by side in the same ovule. The apical region of both the sacs extend beyond the ovule (Fig. 3). Maheshwari[2] states that multiple embryo sacs may arise (1) either from the derivatives of the same megaspore mother cell, or (2) from two or more megaspore mother cells, or (3) from nucellar cells. It appears that the present case has resulted from the activity of the second megaspore mother cell.

The mature embryo sac shows the normal organisation but the antipodals are ephemeral.

We are greatly indebted to Dr. B. N. Mulay for his valuable suggestion and criticism.

Dept. of Botany,   N. C. NAIR.

Birla College,   V. PARASURAMAN.

Pilani, *February* 10, 1954.

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PESTALOTIOPSIS PSIDII ON *PSIDIUM GUAVA*

THE genus *Pestalotia* was first established on the basis of the fungus *Pestalotia pezizoides* de Not. occurring on dead canes of *Vitis vinifera*. Guba[2] confirmed that the species had six-celled spores with hyaline end cells, the apical cell setulate. Patouillard found the fungus on fruits of *Psidium pomiferum* and named it *Pestalotia psidii*. The species has been known to occur on *Psidium guava* in India for a long time.

Patel, Kamat and Hingorani[3] recorded the fungus on fruits at Poona. The writer[8] described the occurrence of the species in Mysore on fruits and leaves of *Psidium guava* along with another fungus *Glomerella psidii* (*Colletotrichum psidii*).

Saccardo[4] created the subgenus *Eu-Pestalozzia* for the forms having spores with hyaline end cells, coloured median cells and two or more apiculate setæ; *Monochætia* for those with similar spores but unisetulate, and *Pestalozzina* for forms with entirely hyaline conidia. He[5] later elevated the subgenus *Pestalozzina* to generic rank and Allescher[1] did the same for *Monochætia*. *Pestalotia* was restricted to the subgenus—*Eu-Pestalozzia*.
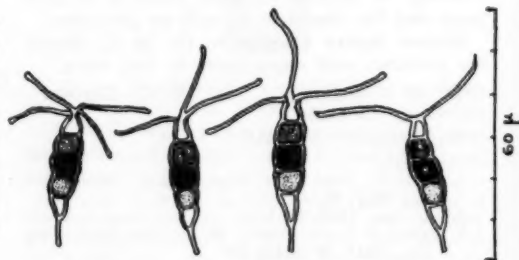

FIG. 1. Camera lucida drawing of conidia from potato dextrose agar culture 30 days old.

Steyaert[6] gave an emended diagnosis of the genus. He reclassified the species and made some new combinations. According to him *Pestalotia* is represented by a single species, *Pestalotia pezizoides*, in which the coloured middle portion of the conidium is divided into four locules by rings forming pseudo-septa and not into four cells by septa. The remaining species are divided into two new genera, *Truncatella* in which the spores are three-septate, and *Pestalotiopsis* in which they are four-septate. He does not accept Saccardo's genus *Monochætia* comprising the species with unisetulate conidia. The spores of *Pestalotia psidii* described by the writer[8] are spindle-shaped, four-septate, median cells coloured, end cells hyaline, apical cell 2-4 setulate (Fig.). The fungus agrees in general characters with those of the section *Trisetulatæ* of Steyaert.[7] Hence the species *Pestalotia psidii* Pat. occurring on fruits and leaves of *Psidium guava* is now proposed to be named *Pestalotiopsis psidii* (Pat.) Venkatakrishniah, comb. nov.

The writer is greatly indebted to Sri. S. V. Venkatarayan, for kind suggestions.

N. S. VENKATAKRISHNIAH.

Plant Pathology Section,

Agric. Department,

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TWO NEW RECORDS OF PHYTO-PATHOGENIC BACTERIA FROM BOMBAY STATE

Alysicarpus rugosus DC., one of the best known green fodder for cattle, is an important legume of Bombay State. A leaf-spot and blight inciting disease of bacterial origin was observed at Jalgaon during the rainy season of 1953. On the leaves, the pathogen produces a few, small, round, water-soaked areas, measuring about 0·5-1·0 mm., mostly at the periphery of the leaf. On further development of the disease, these spots with pale yellow parched centre and brown periphery produce blight symptoms in the leaves which turn yellow, curve and shed. Although the blight symptoms progress along the veins, the pathogen does not become vascular. Besides infecting leaves, it produces canker on injured stem. Since no bacterial disease has so far been reported on this host and as the pathogen is restricted to *Alysicarpus rugosus* only, it is proposed to assign the bacterium a new name *Xanthomonas alysicarpi* nov. sp. whose technical description is given below:

Short rods; single, rarely in chains of two; single polar flagellum; 0·6 × 2·0 μ in size; gram negative; capsulated; no endospores; on potato dextrose agar plates, the colonies are circular with entire margin, smooth, shining, convex with no striation, measuring 2·0 cm. after 8 days, colour pale lemon yellow; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised and litmus reduced; ammonia and hydrogen sulphide produced from peptone; nitrite not produced from peptone-nitrate broth;

M.R. and V.P. tests negative; acid with no gas from dextrose, lactose, maltose, and sucrose; no growth in salicin; optimum temperature for growth 27-30° C.; thermal death point at 51° C.; pathogenic to *Alysicarpus rugosus* only.

A new bacterial leaf-spot of *Bridelia hamiltoniana* Wall., a common waste lands shrub growing along the western coast of India was observed at Ambarnath in July 1953. On the rhomboid leaves, the pathogen produces few to numerous minute water-soaked spots visibly clear on the lower surface of the leaves, measuring initially 0·3-0·5 mm., fairly well distributed all over the leaf-surface. High atmospheric humidity and continuous rains are highly congenial for the development of the disease. With the progress of the disease, the spots increase in size to 1·0 mm., become angular and dark brown. Bacterial ooze in the form of small shining beads is found on the underside of the leaves. The pathogen infects leaves only. Since no bacterial disease has so far been reported on this host and the pathogen being specific to *Bridelia hamiltoniana* only, it is proposed to assign the bacterium a new name *Xanthomonas brideliæ* nov. sp. Its technical description is given below :

Short rods; single; single polar flagellum; 0·5 × 1·7 μ in size; gram negative; capsulated; no endospores; on potato dextrose agar plates, the colonies are circular with entire margin, smooth, shining, convex with no striation, measuring 1·8 cm. after 8 days, colour barium yellow; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised and litmus reduced; ammonia and hydrogen sulphide produced from peptone ; nitrite not produced from peptone-nitrate broth; M.R. and V.P. tests negative; acid but no gas from dextrose, lactose, maltose and sucrose; no growth in salicin; optimum temperature for growth 27-30° C.; thermal death point about 51° C.; pathogenic to *Bridelia hamiltoniana* only.

Fuller details will be published elsewhere.

Plant Pathological Lab., V. V. BHATT.

Agric. College, Poona, M. K. PATEL.

February 16, 1954.

THE ANTIPODALS IN THE FAMILY AMARANTHACEAE

IN the April issue (1954) of this Journal, Bakshi[2] has published a note on "The Antipodals in the Family Amaranthaceae". He says he has failed to confirm my previous observations in respect of the multiplication of the

antipodals in *Pupalia lappacea*. Bakshi's findings prompted me to re-examine my old slides. The results of rechecking confirm my original observations.

As previously reported by the author[4] the antipodals in *Pupalia lappacea* do multiply to form a small mass of cells which in its capacity to stain more deeply differs markedly from the surrounding tissue of the nucellus. Secondly the nucleoli, in general, of the antipodals are bigger and are more conspicuous than those seen in the nuclei of the neighbouring nucellar cells. Such differences would hardly ever arise when, to quote Bakshi, "in an oblique section a few cells of the perisperm are cut off in such manner that they appear to be embedded in the cavity of the embryo sac".

The cells of the perisperm which Bakshi suggests, appear embedded in the cavity of the embryo sac would naturally be expected nearer the concave side of the embryo sac. I have, however, seen such multiplying antipodals in many cases nearer the convex side of the embryo sacs cut in median plane, which precludes even a distant possibility of perisperm cells appearing embedded in the cavity of the embryo sac. My Fig. 14 g^1 is significant. It is sketched from a median section. It shows one enlarged and vacuolated, and four small antipodals. Such enlarged and vacuolated antipodals are also noted by Bakshi. It would be incorrect to conclude from this figure that four small antipodals are the cells of the nucellus along with one enlarged antipodal.

At a stage when the embryo sacs become 300-400 microns in length, the antipodals are situated at a distance of about 150-200 microns from the micropylar end of the embryo sac. Such a regular spacing of what Bakshi regards as nucellar cells would be beyond all comprehension.

During the early stages of embryo development the degenerating antipodals appear as darkly stained structures. Could it happen with the perisperm cells which Bakshi suggests, might appear embedded in the embryo sac?

An increase in the number of antipodal cells has been observed in several families of the Centrospermales like the Nyctaginaceae,[3,6,7] Chenopodiaceae[1] and Phytolaccaceae.[5] In respect of this feature then the case of *Pupalia lappacea* would bring the Amaranthaceae in line with the other families of this order. Embryological investigations on several species of the Amaranthaceae are in progress and the subject would be discussed fully elsewhere, but let us not in the meanwhile compel the Amaranthaceae to follow a rigid sequence of development in having only three antipodals.

M.A.C.S. Laboratories, L. B. KAJALE.
Law College Buildings,
Poona 4.
April 30, 1954.

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CENTRAL SALT RESEARCH INSTITUTE, BHAVNAGAR

THE Central Salt Research Institute, Bhavnagar, was declared open by the Prime Minister, Pandit Jawaharlal Nehru, on April 10, 1954.

In view of the facilities offered by the Saurashtra Government for the establishment of the Institute, the Council of Scientific and Industrial Research decided to set up the Institute at Bhavnagar. Efforts are being continued to establish a salt research laboratory at Sambhar and other research stations and model salt farms at Madras, Travancore and Orissa in accordance with the recommendations of the Salt Research Committee.

The Institute is the twelfth in the chain of national laboratories. The main function of the Institute will be to work out methods for improving the quality of salt and to increase the salt production for domestic as well as industrial uses. The sources of salt, such as sea and lake brines, contain besides salt, other important chemicals. It will be the object of this Institute to conduct research on the chemical recovery of the by-products as such or to utilize them for the manufacture of other industrially useful chemicals. The work of the Institute will be carried out in three divisions: (1) Division of Inorganic Chemistry; (2) Division of Physical Chemistry; and (3) Division of Chemical Engineering. The Institute will also have a library and research information service, a museum and a workshop. A salt farm will be established under the technical guidance of the Institute.

REVIEWS

Television Receiver Design. (*Monograph 2: Flywheel Synchronization of Saw-Tooth Generators, Book VIII b of the Series of Books on Electron Valves*). By P. A. Neeteson. [Philips Technical Library ; Distributors in India : Phillips Electrical Co. (India), Calcutta 20], 1953. Pp. 156. Price 21 *sh.*

Vol. VIII of this popular series deals with television receiver design. There is a larger work on "Television" by Kerkhof and Werner in Philips Technical Library to which the reader is referred, when looking for basic information. Book VIII is therefore intended for specialists in the field, and its subdivision into single monographs emphasises this tendency still further. The design of TV receivers deviates in many aspects from the conventional broadcasting receiver design. These monographs deal primarily with such absolutely new design problems. The first monograph discussed the wide-band IF amplifier technique. About three-quarters of the present one is devoted to one particular horizontal synchronisation circuit which has gained enormous popularity amongst receiver designers. Up to now it was an elaborate job to collect all the required information about this circuit from many journals and only skilled designers could fight their way through the diverging views and notations of a dozen different authors writing in different languages.

This little volume fills therefore a gap in the TV literature and its publication has been anxiously awaited by the specialists. Their high expectations have been fully met. We find in the first quarter a concise introduction to saw-tooth generators and their synchronisation. The fundamental idea of charging a storage element in a short interval over a gated tube and leaving it discharging with a constant rate over a longer interval leads automatically to 2 basic systems: capacitive or inductive saw-tooth generators. The latter type confronted the designers with new problems which could only be solved by the introduction of new "electronic valves developed for saw-tooth generators". Full data of ECL 80, EY 51, PL 80, PL 82, PY 80, PY 81 are therefore included.

"Flywheel synchronisation," the main subject of the book, greatly reduces the effects of noise and man-made interference on the quality of the received picture. It is largely applied in modern TV receivers, except in the cheapest types. It is unavoidable for receivers located in fringe areas.

The full theory of the circuit is presented and all possible variations of the basic circuit are indicated in clear diagrams. The many charts in the book will aid the designer in predicting the performance of the circuit in any specific application.

The specialists will hope that more monographs of this type will follow and that they may cover equally difficult problems like Flyback-EHT supply or AGC-control circuits in TV.

R. FILIPOWSKY.

Radio Receiver Design, Part I. (Second Edition, Revised). By K. R. Struley. (Chapman & Hall, London), 1953. Pp. 667. Price 56 *sh.* net.

The first edition of this volume on the specialised branch of Radio Engineering, covering radio frequency amplification and detection, appeared exactly ten years ago when the undersigned had the pleasure of reviewing it in these columns of *Current Science*, in 1943. Its usefulness and popularity will be evident from the fact that, in between the two editions, the book went through five impressions justifying the hopes expressed at its first appearance. This is due perhaps to the science of electronics and radio having made phenomenal strides during the period, and certainly due to the dearth of books dealing, exhaustively and authoritatively, with the subject of radio receiver design.

The extent of revision and additions in the present volume is reflected in the number of pages showing an overall increase by 50 per cent. over the first edition. Problems of 'noise', wherever they occur—in valves, aerials or at aerial sites, etc.—form a very important and major addition to the text. Chapter I, dealing with fundamentals of transmission and reception, includes a section on signal-to-noise ratio and noise factor while Chapter II, on valves, contains treatment of valve noise, its calcula-

tion and measurement, in addition to the usual discussions on valve perameters, vector diagrams, and equivalent circuits, etc. New material in Chapter III, on aerials and aerial coupling circuits, consists of treatment of wavetraps, balance-to-unbalance aerial feeder connection for interference reduction. Additional information on self-capacitance and mutual inductance of coils is given in Chapter IV on RF amplification besides rewriting the section on RF noise. Little alteration has been made in Chapter V, on 'frequency changing', which describes superheterodyne and synchrodyne principles and the properties required of a frequency changing valve, including noise arising in such circuits. In Chapter VI, on oscillators for superheterodyne reception, principles of all types of oscillators, their frequency variations, etc., are covered, special features being the section on ganging of oscillator and signal circuits including effects of component tolerances on frequency. Chapter VII on intermediate frequency amplification covers, in addition to the rearrangement of old material on coupled circuits, variable selectivity, design of IF transformers, etc., exhaustive treatment of crystal coupled IF transformers. The last chapter on detection has undergone only minor changes. Four new appendices have been added on "Network equivalents".

The order of treatment, which is reverse of that usually found in books on radio engineering, has been retained in this edition, presumably due to the success of the first edition. The limitation imposed by the choice of subject-matter may be responsible for this, as was remarked while reviewing the earlier edition, for it is a point to consider whether one designs a radio receiver from its terminal end or at the aerial end! However it can be stated unhesitatingly that the author has succeeded in bringing out the essentials of design of various types of radio receivers—AM, FM, VHF, etc., using freely analytical methods at every stage of development and giving numerical examples. A useful list of references to original papers follows each chapter.

The reviewer warmly recommends the present volume to students and teachers alike in the fascinating field of radio and electronics, who will find it valuable for study and reference. Those engaged in receiver design will eagerly await the revised second edition of Part II of the book. The price of 56 *sh.*, which is twice that of the first edition, is a little high.

N. B. BHATT.

Mechanical Vibration. By G. W. Van Santen. (Published by Philips' Technical Library, Eindhoven.) [Distributors in India : Philips Electrical Co. (India), Calcutta 20], 1953. Pp. xvi + 296. Price not given.

An experimental approach to vibration problems involves the use of quite elaborate commercial equipment, literature on which are only available from company catalogues. The author of this book is attached to the industrial control and measuring apparatus department of Philips Industries—a firm which has vast experience in the building of equipment used in the study of vibration phenomenon. The author is consequently well qualified to deal with vibration instrumentation. Three chapters of the book (pp. 208-78) are in the reviewer's opinion, an outstanding feature of this book. In it are dealt the principles of equipment for the measurement of vibration, instruments for the measurement of vibration and some practical hints on vibration measurement. These three chapters will interest all readers concerned with problems arising from vibration or whose work entails the measurement of vibration.

In the remaining 200 pages of the book, the author deals with linear vibration, non-linear vibrations and relaxation oscillations. There is no departure from the classical treatment though the author has spiced it with numerous examples and analogies to illustrate points from theory.

There are a few errors, both typographical and grammatical, in the book which the reviewer hopes will be removed in the next edition.

The reviewer commends this book to all interested in vibration problems and feels that the book justifies its appearance as it fills the need for a book which clearly sets out the rudiments of vibration instrumentation.

A. RAMACHANDRAN.

Recommendations for the Disposal of Carbon-14 Wastes. (National Bureau of Standards Handbook 53). (Order from the Government Printing Office, Washington 25, D.C.). Pp. 14. Tables 2. Price 15 cents.

The recommendations contained in this handbook were prepared by the National Committee on Radiation Protection, Sub-Committee on Waste Disposal and Decontamination.

As the problem of the disposal of radio-active wastes varies over such wide limits, depending upon the usage to which the iso-

topes are put, the NCRP decided that it was not feasible to incorporate in one volume broad recommendations covering all situations and materials. Accordingly, individual reports dealing with particular conditions will be issued from time to time. Handbooks 48, 49, 51, 52 and 56 dealing with problems of contamination, waste disposal and instrumentation have already been published.

The disposal recommendations are divided into six sections: Isotopic dilution, Sewers, Incineration, Atmospheric dilution, Garbage and Burial. In addition the handbook contains general considerations, bases for recommendations and references.

Industrial Inorganic Analysis. By Roland S. Young. (Chapman & Hall), 1953. Pp. viii + 368. Price 36 sh. net.

The scope of applied analytical chemistry has become so wide that no one man can hope to be an expert in all its fields, and no text-book can cover all the ground. It is no exaggeration to say that the author of the book under review has made a supreme effort to include as much material as possible in a short book. Even though Mr. Young modestly claims that his book is mainly intended for the younger analytical chemists, it can definitely serve as a useful guide book in any analytical laboratory.

The author has made two general changes from the usual practice of writing books on analytical chemistry. He treats every element individually and according to their alphabetical order and not according to groups, and secondly only the most simple and the most suitable methods for the separation and determination of the various elements are dealt with, instead of compiling a number of methods and leaving the selection of a particular method to the reader. Even though the details of the various methods described are freely drawn from classical books on analytical chemistry, the selection of the particular method is original and their treatment is based purely on the personal experience of the author. However, there are a number of instances wherein some of the most obvious and simple methods are overlooked, as for instance in the determination of manganese. Volhard method, which is highly dependable and capable of wide application, is completely left out. For ferrous iron determination the procedure given is vague and is likely to give erroneous results. Further, no method is given for determining ferrous iron in insoluble materials like silicates. Excepting

for a few passing references, no serious attempt is made to describe any of the well known (instrumental) physical or physico-chemeical methods adopted for analytical work in modern inorganic industrial laboratories. Considering the fact that this volume was not intended to be a comprehensive treatise on inorganic analysis these shortcomings may be overlooked. However, this book is a valuable contribution to inorganic analytical chemistry and it will be found very useful to not only the undergraduates in chemistry but also to the practising analytical chemists.

N. JAYARAMAN.

Biology of the Cryptic Fauna of Forests, with Special Reference to the Indigenous Forests of South Africa. By R. F. Lawrence. (Published by A. A. Balkema, Cape Town), 1953. Pp. 408. Price 50 sh.

As the author himself admits in the preface, he had some difficulty in choosing the title of this book which deals with the ecology of the fauna living hidden in the *forest floor*. In the words of the author (p. 7): "My object has been to give a general account of the animals which are to be found in the humus of the South African forests, their biology and background." The author's expressions 'cryptic fauna', 'cryptozoic fauna' and 'cryptozoa', therefore, do not adequately explain the scope and the limitations of the contents, since even the insect borers which live inside tree trunks are 'cryptozoa'.

The book opens with a chapter on the general characteristics and distribution of the forests of South Africa. This is followed by an interesting discussion on the faunistic composition of the forest floor and a comparison of that fauna with other biological communities. In the four subsequent chapters such aspects as form and colour, movement, respiration and the sensory organs are considered. Then follow the chapters on weapons, enemies and parasites, reproduction and development, postnatal growth, food and economics, and, finally, there is a discussion on distribution in space and time. At the end there is a list of selected bibliography, an author index and a general index.

The mode of treatment of each section is in the form of an essay and more than ordinary emphasis has been laid on morphology. Among the animal phyla and classes dealt with are: Protoza, Platyhelminthes, Nemathelminthes, Annulata, Mollusca, Arthropoda (including

Onycophora, Crustacea, Myriapoda, Arachnida and Insecta). Among the insecta references have been made to the Collembola, Thysanura, Hemiptera, Orthoptera and Coleoptera. The omission of the Isoptera (termites) is difficult to understand since termites form an important element in the forest floor and are rich both in species and in numbers. The Acari (mites) have also been dealt with all too briefly.

The illustrations are well drawn and the photographs are of excellent quality. The printing and get-up of the book leave little to be desired.

By and large this is a good and well presented compilation of the available knowledge of the fauna of the forest floor of South Africa and should be of interest to all students of animal ecology and, in general, of zoology.

M. L. ROONWAL.

Poisonous Plants of India, Vol. I. (*Scientific Monograph No. 17, The Indian Council of Agricultural Research*). By R. N. Chopra, R. L. Badhwar and S. Ghosh. (Government of India Press, Calcutta), 1949. Pp. liv + 762. Price Rs. 30.

Little is known about the physiological significance of the occurrence of complex organic compounds—such as glucosides, resins, toxalbumins, fixed and essential oils, bitter principles, alkaloids and steroids—elaborated following the basic, photosynthesised sugars in tissues of green plants. Many of them, doubtless poisonous, have been recognised by man as useful specifics in the alleviation of human suffering. Knowledge of plants with medicinal properties, plant narcotics and abortifacients dates back to very early times in the history of India, though useful references are meagre and scattered. The monograph on "Poisonous Plants of India" offers a fine compilation of descriptive and distributional accounts of indigenous poisonous plants in general, pharmacognostical informations, details of the chemistry and physiological activities of the active principles and mode of treatment wherever experimental evidence is obtainable.

The Introduction is a comprehensive chapter giving concise accounts of meteorological conditions, topography and zonal vegetations of this country, historical review, explanatory account of the toxic constituents of plants, action of poisons, symptoms, diagnosis and prognosis of poisoning, treatment and prevention, supplementary lists of insecticidal plants and those poisonous to fish and lastly synopsis of natural orders, following Bentham and

Hooker's System of Classification of Higher Plants. 192 species of poisonous plants belonging to families Ranunculaceæ to Convolvulaceæ are dealt with in detail in this volume.

This well-written monograph is welcome as a useful standard reference work for botanists, chemists and pharmacologists engaged in the search for newer plant remedies. The possibilities of establishing several more efficacious drugs from plant products are undoubtedly enormous and promising and can never be overemphasised in view of the fact that the list of drug plants having an established reputation in modern medicine form only a fraction of the vast number of plants, the potentialities of which demand thoughtful, extensive and intensive experimentation. This book would also be educative to a good majority of the lay people in this land. People of other countries will find it informative and useful because of the close link in the representation of plant genera and species in India with both the Eastern and Western land formations. I will be failing in my duty if I do not congratulate our veteran 'alkaloid-hunter' Dr. Sir Ram Nath Chopra and I, therefore, do so with genuine pleasure. T. S. SADASIVAN.

Books Received

On the Congruence of Sets and Their Equivalence by Finite Decomposition. By W. Sierpinsky. (Lucknow University Studies No. XX, Faculty of Science Session, 1948-49), 1954. Pp. 117.

The Collected Papers of Peter. By J. W. Debye. (Interscience Publishers, Inc.), 1954. Pp. xxi + 700. Price $ 9.50.

A Compilation of Papers on the Assam Earthquake of August 15, 1950. By M. B. Ramachandra Rao. (Central Board of Geophysics), 1953. Pp. vii + 112.

Geometrical Mechanics and De Broglie Waves. By J. L. Synge. (Cambridge University Press), 1954. Pp. vi + 167. Price 25 *sh.*

A New Periodic Table of the Elements Based on the Structure of the Atom. By S. I. Tomkeieff. (Chapman & Hall), 1954. Pp. 30. Price 10 *sh.*

The Physics of Experimental Method. By H. J. J. Braddick. (Chapman & Hall), 1954. Pp. xx + 404. Price 35 *sh.*

Optical Workshop Principles. Second Edition. By Charles Deve. English translation by T. L. Tippell. (Hilger & Watts, Ltd., London). Pp. xxiv + 436. Price 42 *sh.*

SCIENCE NOTES AND NEWS

Occurrence of Hepaticeae in Bihar

J. G. Srivastava, A. S. Yadav, A. S. Mehta and D. V. Saxena of the Department of Botany, Patna University, write as follows:

Ten species of Liverworts belonging to nine genera have been recorded from the Parasnath Hills in Bihar. They are *Dumortiera hirsuta* (3,500'), *Targionia hypophylla* (4,000') *Cyathodium tuberosum* (4,000'), *Plagiochasma articulatum* (4,500'), *P. appendiculatum* (4,500'), *Marchantia polymorpha* (4,500'), *Riccia himalayensis* (900'), *Fimbriaria nepalensis* (4,500'), *Anthoceros himalayensis* (4,500'), *Notothylas indica* (4,500'). In addition, *Riccia fluitans* and *Ricciocarpus natans* were collected from Topchanchi lake (800'). Also *Riccia sanguinia* and *R. pathankotensis* were collected on the plains (170') at Patna, the former on the lands left by Ganges and the latter in the Botanical Gardens of the Science College, Patna.

Achromatic Combination of Two Lenses

Shri Mahendra Singh Sodha and A. N. Nigam, Allahabad University, write as follows:

The error in the earlier note by the authors (*Curr. Sci.*, 1953, 22, 232) pointed out by Murthy (*Curr. Sci.*, 1953, 22, 369), is purely due to the use of a sign convention different from the customary one. Further, it is impossible to obtain complete achromatism with two lenses of the same material. Murthy obtained such an erroneous result because he assumed the sum of two equations to be true, while they have to be individually satisfied.

Element 100

The century of chemical elements has been completed by the making of Element No. 100 by workers in Professor G. T. Seaborg's Department in the University of California.

Whereas element 99 was first made by bombarding uranium with the nuclei of nitrogen atoms accelerated to high energies in a laboratory machine, element 100 has been made from plutonium by heavy exposure to neutrons in a nuclear reactor. The reactor used was the Atomic Energy Commission's "materials testing reactor" at Arco, Idaho, and the experiments were done by B. G. Harvey, S. G. Thompson, A. Ghiorso and G. R. Choppin, Professor Seaborg's associates.

Irradiation was in two stages. In the first, plutonium (element 94) was converted into californium (element 98) and this was separated chemically from both the plutonium and the other products. The californium was then again irradiated and elements 99 and 100 obtained from it. Element 100 is the first new chemical element to be made in this way. Although the quantity of it available was very small, its chemical identification is considered definite.

Just as element 99 showed analogies with the rare earth element holmium (element 67), so element 100 shows analogies with the succeeding rare earth element, erbium (element 68). In the form in which it has been prepared, it has a half-life of about 3 hours and an atomic weight of 253, the highest yet reported. The element is said to have no application either in atomic weapons or the development of atomic energy.

European Council for Nuclear Research

The European Council for Nuclear Research has decided to offer the Directorship to Professor Felix Bloch, Nobel Laureate in Physics, who is now attached to Stanford University, U.S.A.

As Professor Bloch would not commit himself for longer than 2 years, the Council has elected Professor Eduardo Amaldi, of the University of Rome, as Deputy Director, and Professor C. J. Bakker, of the University of Amsterdam, as representative of the scientific group leaders.

X-Ray Camera to Study Materials at 4,000° F.

An X-ray camera capable of studying materials at temperatures up to 4,000° F. has been developed at the Oak Ridge National Laboratory, U.S.A. The camera is being used in ceramics research work by staff members of the Metallurgy Division of ORNL. Designed by J. R. Johnson, a technical adviser, the camera has been used successfully to produce diffraction patterns in studies of hafnium oxide, as well as a number of other oxides and metals.

To photograph the diffraction pattern of the material under study, X-rays produced in a standard X-ray tube pass through a tube guide mounted on the film holder, then through a small disk of beryllium and a collimator. The X-rays strike a rotating sample and are diffracted through a beryllium "window" and the pattern image is registered on photographic film.

Electrochemical Processes and Their Applications to Indian Industry

A symposium on "Electrochemical Processes and Their Applications to Indian Industry" was held in the Central Electro-Chemical Research Institute, Karaikudi, on the 27th and 28th March 1954. Research workers from various laboratories, and representatives of industry and of Government Departments numbering nearly 40 attended the proceedings. Sir S. V. Ramamurthi, who inaugurated the symposium, pointed out the vital rôle that the electrochemical industries play in a modern economy and looked forward to an industrial revolution in this country based on wood and electricity instead of that based on iron and coal as in Europe.

51 papers were presented at the symposium covering the following subjects: Electro-metallurgy and electrothermal processes; Electrolytic processes, inorganic and organic; Batteries, electrodeposition and electropolishing; Miscellaneous, including papers on electric discharges and electroanalysis.

ATIRA

The Ahmedabad Textile Industry's Research Association which was recently declared open by the Prime Minister, Pandit Jawaharlal Nehru, is an institution organised on a co-operative basis, the membership being thrown open to all the textile units in the country. One of the outstanding features of the ATIRA is the strong and valuable support it has been receiving from industry as well as the Government, from labour as well as from technicians. The scope of its activities is not restricted to the fields of technology and physical sciences, but includes social sciences also.

Directory for Arid Zone Research

UNESCO has just published a "Directory of Institutions Engaged in Arid Zone Research" which gives detailed information about institutions engaged in scientific and technical research on problems of arid and semi-arid areas. It is a 110-page volume in the series devoted to the Organization's activities on behalf of developing and increasing the contributions of arid zone research to the improvement of the living standards.

The Directory contains 5 chapters, each dealing with a Continent, listing the countries and institutions in alphabetical order. In addition to the title, address and location of each research institution, other particulars given include its history, aim, nature, structure, programme and equipment. The price of the publication is $1.50.

Composite Wood

A Journal with the above title has been started to promote the study and practice of the science and technology of composite wood—adhesives, plywood, laminated and other improved woods, building boards, etc.—and allied subjects.

The opening number contains four articles: Steaming and Boiling of Logs for Veneer Production, by F. Kollmann; A Small Infra-red Dryer, by D. Narayanamurti and B. N. Prasad; Prolamin Film Adhesive, by D. Narayanamurti and H. C. Pandey; Utilization of Tapioca Steams and Hoop Pine Bark, by D. Narayanamurti and Jastinder Singh. The section on Abstracts is bound to be highly useful to students and research workers in the field. Further particulars can be had from the Editor (Dr. D. Narayanamurti), 15, Beeson Road, Forest Research Institute, New Forest P.O., Dehra Dun, U.P.

Research Studentship in Geophysics at Cambridge

The Royal Dutch Shell group of oil companies is offering a research studentship in geophysics of value £ 450 a year (£ 500 for married men) and tenable for 2-3 years at the University of Cambridge, which is open to men of any nationality less than 27 years old. Further information can be obtained from Mr. B. C. Browne, Department of Geodesy and Geophysics, Downing Place, Cambridge, to whom application must be made by July 1.

Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Botany to Shri C. Venkata Rao for his thesis entitled "Floral Morphology and Embryology of Malvales".

The University of Mysore has awarded the D.Sc. Degree in Chemistry to Shri A. R. Vasudeva Murthy for his thesis entitled "Studies in the Chemical Behaviour of Some Compounds of Sulphur".

The University of Saugar has awarded the Ph.D. Degree in Chemistry to Shri G. S. Rao for his thesis entitled "Iso-polyacids and Their Salts".

The Osmania University has awarded the Ph.D. Degree in Physics to the following: P. G. Puranik—"Studies in Raman Effect: Influence of Environment on Group Frequencies"; K. S. Iyengar—"Photo-Elastic Properties of Solids as Studied by Ultrasonic Methods"; K. V. Krishna Rao—"Photoelastic Effect in Crystals".